MACHINE DESIGN

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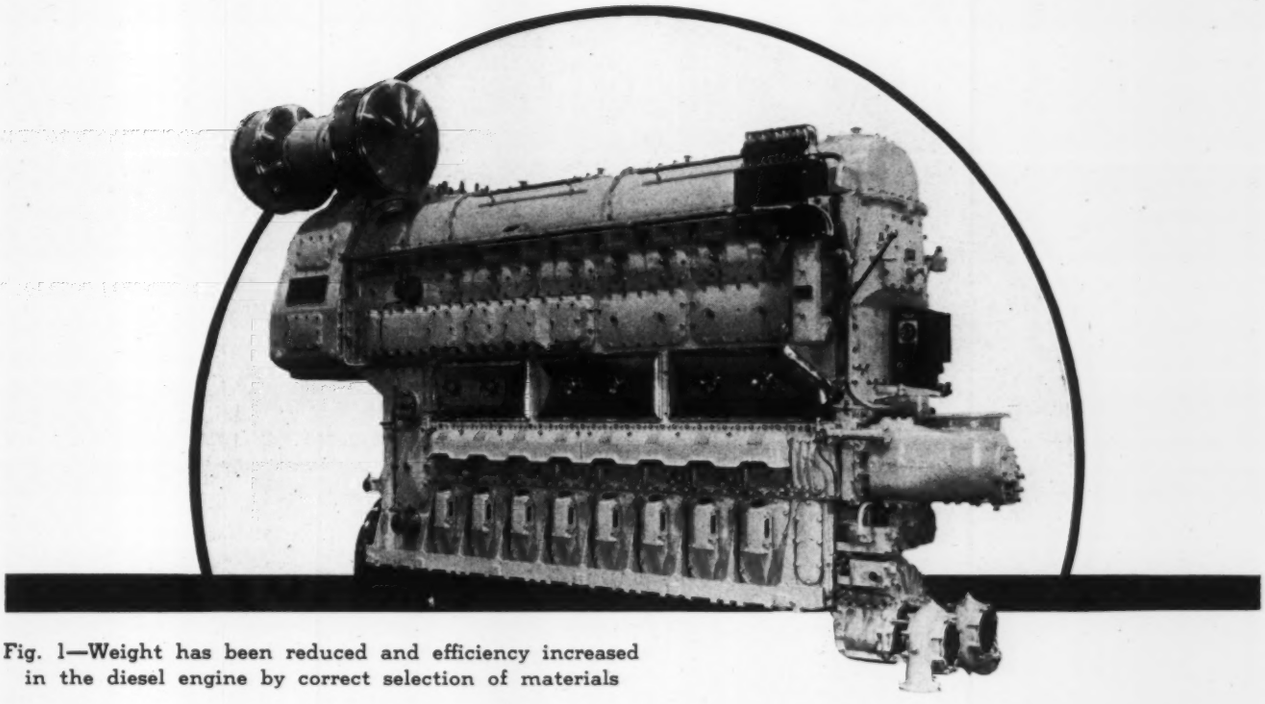

Fig. 1—Weight has been reduced and efficiency increased in the diesel engine by correct selection of materials

Properly Chosen Materials Spell New Era for Diesels

By Harold F. Shepherd

TO MEET an ever-widening field of application diesel engines have undergone, and are still undergoing, radical changes. From mechanisms so large and heavy that they required a foundation of piles sunk deep into the ground, diesels are now built that efficiently power airplanes. Responsible in great part for this redesign of heavy, unmovable equipment is the use of light alloy materials. By careful selection of materials weight has been reduced so that a ratio of only a few pounds per horsepower is common. Life of bearings, cylinders, valves and other moving parts also has been increased appreciably by the use of alloyed materials, obviating the need for frequent overhauls and expensive replacements.

The diesel engine is no longer a simple prime mover served by a number of auxiliary machines. Many marine engines and all industrial and automotive engines are complete power plants. Built into the former are fresh and salt water pumps, fuel transfer pumps working at low pressure and fuel injection pumps working at thousands of pounds pressure. *Fig.* 1 shows a modern diesel with auxiliary attachments built as part of the engine. Attached air compressors for starting and for injection air are common. Blowers for scavenging air, and exhaust turbine-driven blowers for supercharging are other attachments. Hydraulic and compressed air servo-motors are used for governing and maneuverng. With this picture before us it

may not be presumptuous to suppose that the experiences of the diesel engine designer are of value in general machine design.

The following is a review of events in selection of materials during the late depression and the present resumption of business.

CRANKSHAFT MATERIALS—Open-hearth carbon steel of forging quality is still the prevailing material for crankshafts, since stresses are light when the shaft is sufficiently rigid. Small shafts for automotive type engines are drop forged of S. A. E. 1035 to 1045 steel. Some alloy bars are used but because of wear and dilation of die impressions when drop forging the harder steels, the practice is not popular with the forge masters. Quotations for such shafts are usually high.

Nevertheless, hard journals are required with some of the newer bearing metals. Therefore it is necessary to drop forge shafts of a material which has sufficient carbon for water hardening. The carbon, of course, may be held at a minimum by high manganese or other alloying agents.

The present hardening processes apply instant electric induction or flame heat followed by water spray. Machine for hardening crankpins, main journals, cams and similar parts is shown in *Fig.* 3. Inset is of a cross section of a forged shaft in which the depth of tempered steel is easily seen. No method has yet been found to case carburize and harden many crankshafts without excessive distortion.

Intermediate sizes of crankshafts continue to be produced by the closed die process in which each individual throw is bent and slightly formed or upset in a cast die closed by a hydraulic forging press. Oil hardening steel S. A. E. 1045 is usual for this purpose.

Large shafts eight inches and more in diameter usually are made of oil hardening steel with moderate carbon to Lloyds or American Bureau requirements. The basic material requirement is a tensile strength limitation of 58,000 to 62,000 pounds per square inch. Experience still shows that this material when annealed or air quenched and drawn to about 1200 degrees Fahr. is tough and most reliable in sections too large to benefit by heat treatment. Large solid forgings of alloy steel require extreme care to avoid failures attributable to forging or heat treatment.

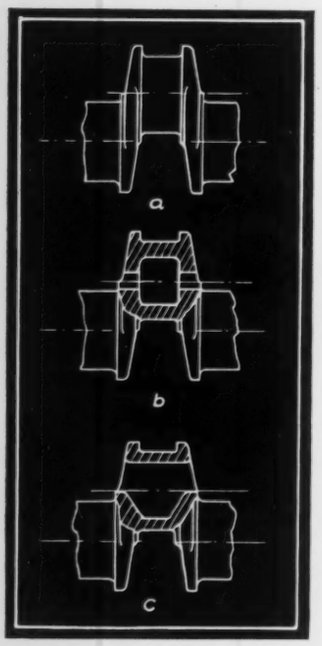

Fig. 2—Weight is reduced in throw of crankshaft by using cast unit with cored hole, shown in bottom drawing. Space does not permit straight drilling in forged shaft shown in upper view, and chamber drilling, shown in the middle, is expensive

Cast Crankshafts Gain Headway

The cast iron crankshaft for multicylinder engines made a startling appearance a few years ago and is still used under certain conditions. High speed engines are usually short stroke with high pressure, many of them operating at 1000 pounds per square inch cylinder pressure. To save weight and space the distance between cylinder axes is usually limited to one and a half times the bore. If bearing areas are to be made adequate under these conditions short pins and journals of large diameter are required. The result is a design like *Fig.* 2a in which pin and journal overlap so much that a large bore through the pin is impossible. Such large centrifugal masses are of course intolerable since they set up large bending moments in the frame and throw undesirably large horizontal loads on the boxes. Chamber boring, *Fig.* 2b, may be resorted to in less extreme cases but this is expensive. The cast shaft permits coring as in *Fig.* 2c. It is made usually of chrome nickel, molybdenum iron with low silicon and high combined carbon, being harder and more wear resistant than the mild steel shaft, one of its most valuable properties.

Torsional Stiffness not Sufficient

It is unfortunate that this facility in making large shafts with light pins does not confer the greatly desired torsional stiffness. A hollow cast iron shaft of a diameter equal to the cylinder bore—and it must be hollow in the larger sizes to avoid excessive shrinkage—has about the same torsional stiffness as a solid steel shaft of five-eighth the diameter. Furthermore, sections are slightly irregular because of coring, and the modulus of elasticity is not constant among shafts from various heats. Consequently, great design skill is required to avoid criticals, and some compensating means may be used to adjust the shaft system frequency, as a small front end balance wheel, the mass of which is adapted to each shaft by test.

The cast shaft is by no means cheaper than the drop forged shaft in small automotive sizes. Material, labor and perhaps equipment costs are lower for drop forgings. In large sizes, however, much machine work is avoided in the cast shaft since the gaps for crank-

pins and center bearings are cut from the solid in the free press forged shaft.

Occasional inclusions appearing on the surface of cast journals are practically unavoidable. They usually are quite harmless but are a cause of dissention between foundry and shop, shop and inspector, firm and customer. X-ray has been applied in such cases but it is not very satisfactory on involved angular sections and is costly. The good wearing qualities of the cast shaft obviously are purchased at a price.

More Shafts Will Be Hardened

BEARING MATERIALS—Comparatively few hardened shafts are in use yet although it appears that in a short time all small shafts (automotive sizes) will be hardened. This may allow a return to the plastic bronze bearings which are themselves superior in wear resistance to the steel in mild steel shafts. Cadmium silver bearings have done good work on hard cast iron shafts but this type also transfers too much of the wear to mild steel shafts.

For general use tin base babbitts S. A. E. 10 and 11 still prevail. It is said that they have never been known to suffer corrosion in an engine. However, at high temperatures the yield point of tin base babbitt becomes very low and a more heat resistant metal must be selected.

Crankpin boxes work at maximum unit pressures up to 2000 pounds per square inch. The oil film pressure at the dome of the curve is probably twice two thousand pounds which is much too close to the elastic limit of babbitt metal under some conditions.

The lead base metals alloyed with the alkaline earths and other ingredients, such as mercury and aluminum in the case of Satco metal, show excellent resistance to heat and impact. They have been used extensively in diesel engines for the past four years. Unfortunately new methods of oil refining have caused certain oils to be marketed which are destructive to lead base metals, a lead soap being formed. Though refiners are careful in applying these oils there has been a temporary set-back in the use of lead alkali alloys, caused by a few cases of misapplication. It is desirable to use these lead base metals as all of the ingredients are plentifully produced in this country and the cost of the alloy is low.

Plating Claims Most Cadmium

The future of cadmium is not yet clear. Cadmium is always found associated with zinc, or lead and zinc, and is a byproduct of the electrolytic refining of zinc. Its price is high and unstable. As long as its production is small, its use for plating probably will claim much of the output and be "cheap at any price."

PISTONS AND RINGS—For all high speed applications aluminum alloy pistons are used almost without exception, both for their lightness and their exceptional heat conductivity. These two properties make it possible to operate uncooled pistons in four-cycle engines at velocities of 2000 feet per second for automotive sizes and 1200 feet per second for diameters as large as 18 inches.

Fig. 3—Crankshaft journals are hardened almost instantaneously in this machine, by electrical induction followed by quenching. Inset shows penetration of hardness

The alloying and heat treating of this type of piston is better left to specialists in piston founding. Most medium and large size aluminum pistons are cast in semi-permanent molds, that is: The mold is iron with a sand core. This results in the chill necessary to give the ring belt sufficient density to prevent excessive groove wear. A few continental and British firms mill pistons from hollow duraluminum forgings, an expensive and tedious process not justified by our experience with cast pistons.

There appears to be a decided trend toward a more open graphitic structure for piston rings. After all, gray iron made the piston engine possible so it is not surprising that an old experience should be confirmed in a search for something better.

CYLINDER LINERS—For general use gray iron of about 200 brinell, more or less, is still our best material for cylinder liners. The structure should be graphitic. For very high pressure, high speed engines hard liners may be required because of the difficulty of maintaining adequate lubrication at all points. Liners often are made in centrifugal molds. Being chilled in the process, the resulting casting is of white iron. Heat treatment restores the graphitic

structure as much as possible while maintaining the required 300 brinell hardness. Such liners are best suited for use as bushings, *Fig.* 4b. With less adequate support, *Fig.* 4a, when used as a wet liner, they frequently fail on account of general brittleness and residual strains produced in heat treatment. Axial as well as circumferential fractures result.

WELDED STRUCTURES—Engine framing, like the crankshaft, must be designed for stiffness. Stresses must be kept low to avoid vibration. Consequently, mild steel well below the usual welding limit of 35 carbon is used mostly for welded frames and bases. Numbers of welded structures have been produced, however, from steel mildly alloyed with vanadium fabricated with specially developed welding rods.

NITRALLOY AND NITRIDING—Fuel pumps and nozzle valves have no packing and depend on gage-like fits between plungers and bushings to avoid leakage. Nitriding is effective in avoiding wear of these parts and corrosion from fuel impurities. Only nitrided surfaces should be opposed. A nitrided plunger working in a bushing of tough metal often scores the latter because of the extreme hardness of microscopic projections on even a lapped surface.

Nitralloy is used for rotors and thrust surfaces of fuel transfer pumps and for small rotary water pumps. In fact wherever grit and indifferent lubrication occurs and a small but persistent amount of contact corrosion takes place nitralloy may be used.

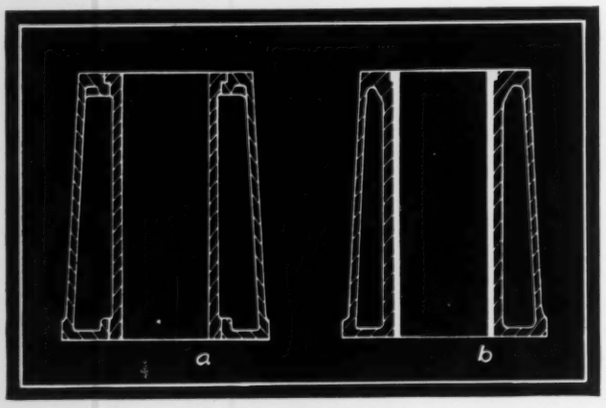

Fig. 4—Care must be exercised in employing wet cylinder liners, as at left, because of lack of support and tendency to brittleness

ANTICORROSIVE MATERIALS—Many failures of stainless steel have occurred due to a general lack of knowledge of its properties. Disregard of heat treatment instructions is a common cause of failure. Welding of stainless steel in locations where subsequent heat treatment is impossible is another cause of failure. To get the most out of this valuable material designers should seek and study advice on each application.

The copper-nickel-aluminum alloy, Monel K, has done remarkable things in corrosion resistance. Cooling water pump shafts and rotary pump rotors operating in contaminated river waters near mines and in salt water are adequately protected when made of Monel K. It also requires heat treatment, a soaking more or less prolonged, for the best results.

USES OF ALUMINUM—Many two-cycle engines now are scavenged by Root type blowers as shown in *Fig.* 1. These blowers are bulky and only by extensive use of aluminum is their weight kept down. The entire structure except shafts, gears and fastenings is usually of light metal, the casing and heads being of No. 10 alloy, and the rotors of the stronger high silicon alloy. Naturally for light engines all cast covers and lighter stressed housings are of aluminum.

Surface Cracks Inconsequential

FREE CUTTING STEEL—The high sulphur, free threading steels are here to stay and it is a temptation to use them in drop forged parts such as fuel pump bodies which have many tapped passages. The usual result is myriads of fine surface cracks caused probably by hot shortness and surface cooling, resulting from contact with the dies. These show up usually after pickling. On sectioning the forgings they are found to be shallow and of no consequence and we may yet convince our inspectors that good threads are of more importance than this external manifestation. This material should not be used for main rod and bearing bolts.

SOLDERING VS BRAZING—Silver solder once little used by mechanical designers is coming into widespread use, particularly for tubing and light semi-tubular structures. Thin and strong joints are the result. A special solder with a considerable percentage of phosphorus (about 5 per cent) is used for bronze and brass on account of its low melting point. It will not solder steel, consequently the silver solders should be carefully specified on drawings, together with a good proprietary flux.

Employment of Nonmetallics

RUBBER—Natural and synthetic rubber have both been used extensively for engine mountings but new uses are being found. Built-in gage boards are always mounted on rubber. The latest use is for the lining of inlet silencers of scavenge pumps which have rubber, ⅜ inch thick, vulcanized to the steel casing. Results in minimizing the tom-tom sound of piston air pumps are remarkable.

In the application of synthetic rubber to cylinder head, water seals and the like, great care must be used. The material is less compressible than rubber. Cases have been found where ring gaskets only a couple of inches in diameter required 25 or more tons compressive force before the head seated home on the copper gas joint. For all such applications dummies should be made and tested in the test machine to determine the force required to seat the gasket.

Scanning THE FIELD FOR Ideas

STAR drills, when used in an electric hammer for drilling concrete, brick and stone, are not held tightly in a chuck as is a twist drill. Instead, they fit loosely in a socket so that the hammer block can rebound from them just as a hand hammer rebounds when doing similar work. There always is a possibility that the drill will fall out of its loose socket or—worse yet—be shot forcibly out of it by action of the hammer when not in working position.

To prevent this dangerous accident, at the same time retaining the advantages of the loosely held tool, the Wodack Electric Tool Corp. has developed a retaining sleeve of molded rubber. This rubber sleeve, not illustrated, fits snugly over the nose of the electric hammer and also over the shank of the cutting tool. Its material is so selected and formed as to hold the tool in place with just the right amount of "play" to insure free and fast cutting. This sleeve also effectively prevents penetration of grit into the socket—a condition which ordinarily is especially troublesome when working overhead.

Cam Replaces Compound Eccentrics

RATHER complicated motion of the needle bar necessarily is characteristic of practically every type of sewing machine. To form a stitch correctly the needle bar first must move downward, then upward to a slight degree. Next comes a short period of rest, followed by a return stroke which completes the cycle.

In the original design of the Reese buttonhole machine, an unusual combination of eccentrics was employed to accomplish this stitching cycle. The unit by which this was accomplished is depicted herewith in the lower portion of *Fig.* 1. This assembly is made up of: A 7½-inch pivoted lever, the forked end of which actuates the needle bar as the lever rocks on its pivot; a large revolving eccentric which is mounted so as to swing on a fulcrum pin on the face of a disk as it revolves; a smaller non-revolving eccentric whose strap is pinned to the face of the larger eccentric which is located and revolves behind this fixed eccentric; and a connecting link by which the "throw" of the revolving and rocking large eccentric is translated to the pivoted lever.

In common with other industrial sewing machines, the effective operating speed of the latest Reese buttonhole machines has been increased far beyond that of the older models. While the compound eccentric mechanism just described was effective at say 1000 revolutions per minute, it was found to set up serious vibration when its speed was increased to 1500 revolutions per minute.

Therefore the engineers sought a new method of actuating the needle bar, with the result that the better balanced and far simpler combination shown in the upper section of *Fig.* 1 was evolved. This requires very little explanation, consisting as it does

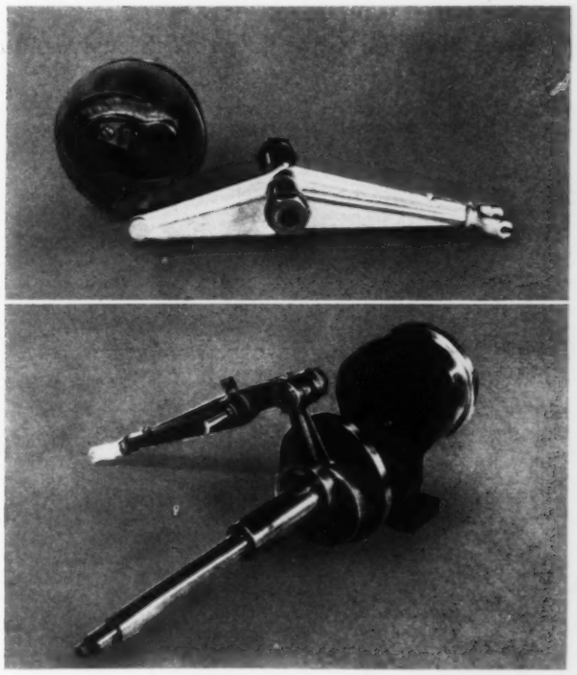

Fig. 1—Lower—Original compound eccentric, and—Upper—High speed cam unit which now replaces it

only of a balanced cam cut in the face of a 3½-inch disk, this cam acting directly upon a follower mounted on the short arm of a redesigned rocking lever, which in turn actuates the needle bar. The new lever, incidentally, is of duralumin, a metal whose light weight eliminates vibration due to oscillation.

Control Makes Presses Safe

BASED on the idea that if both hands of the operator must be at the controls to make a press function, chances for injury to his hands are eliminated, the Tomkins-Johnson Co. has designed the safety system illustrated by *Fig.* 2.

The system utilizes compressed air and essentially is remote control of the air cylinder actuating the main friction clutch. Hand start buttons, a set located conveniently for each man if the operator has a helper, are provided. These are piped in series. Both men must be pressing their respective set in order to actuate the pressure-controlled button which in turn causes the main valve to energize the cylinder, thus engaging the clutch. Hence there is no danger of clutch engagement until all is ready.

Disengagement of the clutch is accomplished automatically by means of a button actuated by a cam on the crank of the press. This "cam stop button" actuates the pressure-operated button, which in turn operates the main valve, causing the cylinder unit to disengage the clutch. There also are hand stop buttons—one at each operating position—enabling either operator to stop the press at will. These are piped from the main air line to a point between the hand open button and the pressure-operated button.

A "hand inching" button is piped through shut-off cocks to lines leading to both sides of the main valve — these cocks being closed except when "inching", the "hand open" button preferably being closed when inching to preclude operation of the main valve by the cam stop button. Provision also can be made for automatic clutch disengagement in case of serious drop in air pressure.

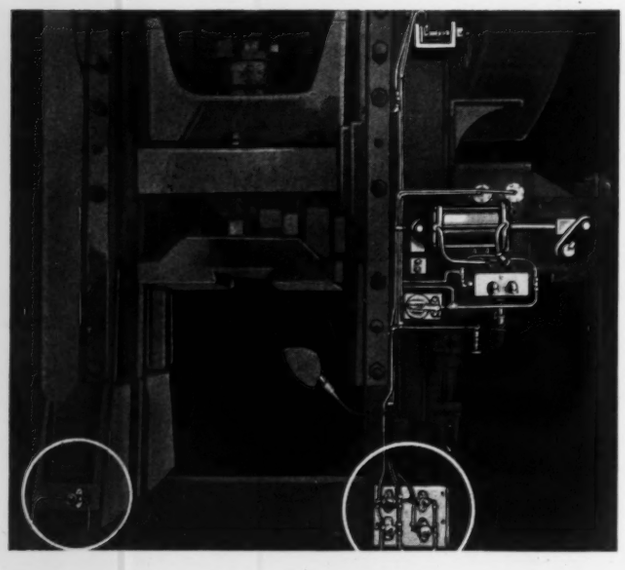

Fig. 2—Double system of press control causes operators automatically to keep hands out of danger

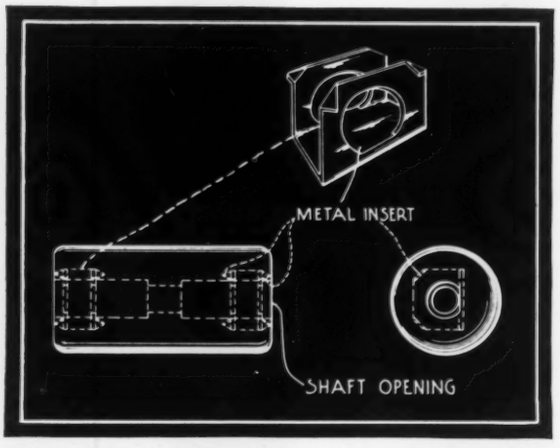

Fig. 3—Details of small flexible coupling, showing metal inserts and manner of molding in

Flexibility for Small Machines

FLEXIBLE driving connections between units of large mechanisms long have been recognized as desirable and necessary in many cases, as is attested by the wide variety of standard couplings available.

The same factors — including easier limits in alignment, smoothing out of pulsations in power-flow and cushioning of shocks incident to starting and stopping — make flexible couplings useful in numerous smaller machines and appliances. This is true particularly of those having so-called "floating power". However, the flexible couplings used on small mechanisms often are nothing more than short sections of hose or rubber tubing.

A more business-like type of small flexible coupling is that recently developed by the Henry Engineering Co. This is shown diagrammatically in *Fig.* 3. The cylindrical body is molded either from rubber or from neoprene, Du Pont's chloroprene rubber. In the ends of the cylinder are circular openings each with a flattened section, into which similarly flattened driving and driven shafts are inserted without need for set screws or keys. These shaft sockets are re-enforced by metal inserts which are molded into the body. Shape and location of these wear resisting inserts are shown clearly in the cut.

A typical example of practical use of these couplings is as a direct connection between motor and oil pump of the oil burner manufactured by the Heil Co., neoprene being used to withstand the oil.

Why We Use It!

Chief Engineers' Views on Selection of Materials

WITH few exceptions, engineers and machine designers today have choice of at least two materials approximately equivalent in characteristics and in price, for vital parts of machines under development. The closer the line is drawn between these alternative materials, the more difficult becomes the selection of that one which will be most satisfactory. This keen competition between materials makes it more than necessary that those closely concerned with specifying the selection, method of machining or molding, heat treating, finishing, etc. shall have authoritative data on the most important characteristics. No one can "carry in his head" the thousands of facts on the hundreds of modern alloys and plastics—hence the directory of materials included as a supplement in this issue.

To emphasize the value of the directory as a work of reference, MACHINE DESIGN has asked several well known chief engineers and other design executives to tell briefly of recent practical experiences in materials selection. Their statements prove how weighty and important has become this responsibility which now rests squarely on the engineering department.

" . . . . . selected to insure safety."

W. W. SMITH, Chief Engineer
Studebaker Corp.

MATERIALS for all vital parts of our cars are selected with a great deal of care to insure proper functioning, maximum safety, appearance where appearance is a factor, and ability to handle in production, the majority of these parts being made from materials used and proved over a number of years.

This year we are adding a new material to our list in specifying Lucite for our instrument group dial. Offhand, you probably will not think of the instrument group dial as a vital part but in case of accident it does assume vital importance. It was with this in mind that we made the selection. Lucite has the transparency necessary for a clear vision of the instruments, yet does not break or shatter under impact. In addition, diffused lighting effects that insure instant readability at night with a material reduction in glare in the driver's eyes are available through its use.

It is more expensive than glass and there have been some manufacturing problems in connection with it but these things seem to us to be of minor importance as compared with increased safety.

Of less importance perhaps but non-the-less active factors in our decision are: the pleasing appearance of the material, its adaptability to the instrument panel opening in which it had to be used, and its light weight and sound-absorbing qualities.

" . . . nickel-chrome-molybdenum spindles."

J. B. SANDO, Chief Engineer
American Laundry Machine Co.

COMMERCIAL laundries use extractors having revolving baskets of 48, 50 and 54 inches in diameter, with capacities respectively of 220, 320 and 420 pounds (dry weight) of material, to remove the surplus water from the material after it has been through the washing machine.

Obviously it is impossible for any operator to load the wet material into these extractor baskets so uniformly that the load will be in perfect dynamic balance. As a matter of fact, a careless operator frequently will put the material into the basket so unevenly that an unbalanced static condition ranging from 15 to 20 pounds exists.

The 48-inch basket has full load operating speed of 750, the 50-inch of 700, and the 54-inch of 600 revolutions per minute. At these speeds centrifugal force developed by unbalanced loads in the baskets of these extractors subjects their spindles to unusual and repeated stresses, over which the manufacturer of these machines has no control.

This accounts for our choice of nickel-chromium-

molybdenum forged steel, SAE 4340, for the spindles of our extractors. This high grade alloy is heat treated to attain the following characteristics: Brinell hardness, 269-302; grain size, 6-8; tensile strength, 145,000; yield point, 125,000 pounds per square inch.

"..... we decided on beryllium copper."

W. W. McDowell, Assistant to Vice President
International Business Machines Corp.

WE have on several of our machines groups of contacts through which, by means of plugable connectors, we are able to make the proper set-up for each type of report which is to be run. As many as 1800 individual contacts are used on one machine.

In selection of material for these contacts, the following four main points must be considered:

1. Good contact between the plugable and fixed points.
2. Permanency of contact.
3. Small size because of large number required.
4. Low cost.

In our early designs we used brass for the base of the contacts and small steel wire for the contact spring, the wire being formed into a loop and clamped into the brass base. This type of contact was not very positive and was quite expensive to make.

Next we tried forming the entire contact out of one piece. The material was phosphor bronze, which we thought would have sufficient spring tension to give a good contact. This proved not to be true, however.

After searching for a material which would be soft enough to be easily formed, and which could later be hardened to spring temper, we decided on beryllium copper. By using this material, cadmium plating it before forming (the plating acts as a lubricant in the dies), stripping the cadmium, and then hardening, we were able to get a contact satisfactory over long periods of time.

"..... usually has considerable choice."

F. E. Cardullo, Chief Engineer
The G. A. Gray Co.

A DESIGNING engineer confronted with the question of what to use for a given part where a high grade material is needed, usually finds that he has considerable choice in the matter because there are a number of materials with practically identical properties. Suppose for example that great strength and toughness are the requirements. He will find at least four different types of alloy steel which, when properly made and heat treated, have practically identical strength and toughness. It usually will be found that the price variation is insignificant, and his choice of a certain steel will depend largely on local conditions. If forgings are required, the suppliers may be more experienced in handling some particular kind of steel, and for this reason will be able to supply better forgings from that material. If bars are required, warehouse stocks may be the determining factor.

The designer naturally takes these things into account in choosing the material which he will specify for the part. The fact that he specified one particular composition of steel is no evidence that in his judgment that particular steel is superior, but only that on the whole he may readily purchase a wholly satisfactory product of that composition.

There are a few products which have some unique property that makes them better for certain service than any other product, although for other service they may offer no advantage. Such a product is nitralloy. The G. A. Gray Company builds milling planers which are frequently equipped with side heads having a boring bar sliding through and driven by a revolving sleeve. For such a bar the strength and toughness of the commonly used alloy steels is ample, when heat treated to machinable hardness. However, at this hardness such a bar may be easily bruised or scratched, hence a hard surface is desirable. Such a surface might be obtained by case hardening, except for warping and machining troubles.

Ammonia Hardens Surface

Nitralloy is a steel which acquires an intensely hard surface (practically twice as resistant to scratching as a case hardening surface) by heating it in ammonia vapor at a temperature of 950 degrees Fahr. from two to four days. While this treatment neither affects the physical properties of the body of the bar, nor distorts it in the least, it does confer upon it a skin of extraordinary hardness, this skin having a thickness of .010 to .015 of an inch. Thus all the advantages of a high quality heat treated steel of machinable hardness, which may be finish machined except for final grinding and lapping, are associated with this hard, scratch-resistant case .

In order to utilize to the fullest the properties of nitralloy, the bar slides in two nitralloy bushes, one at each end of the driving sleeve. These bushes are but a fraction of a thousandth larger in the bore than the diameter of the bar. After its finish grinding, the bar is lapped to an exactly uniform diameter, and after their grinding in place, the bushes are lapped to the required bore diameter. Because of the great hardness and smoothness of the two surfaces and their extremely low coefficient of friction, the bar slides freely through these bushes in spite of the small difference in diameters. Neither bar nor bushes have any tendency to cut, stick or gall, and there is very little tendency to corrode.

Plastics in Machines—I

By J. Delmonte

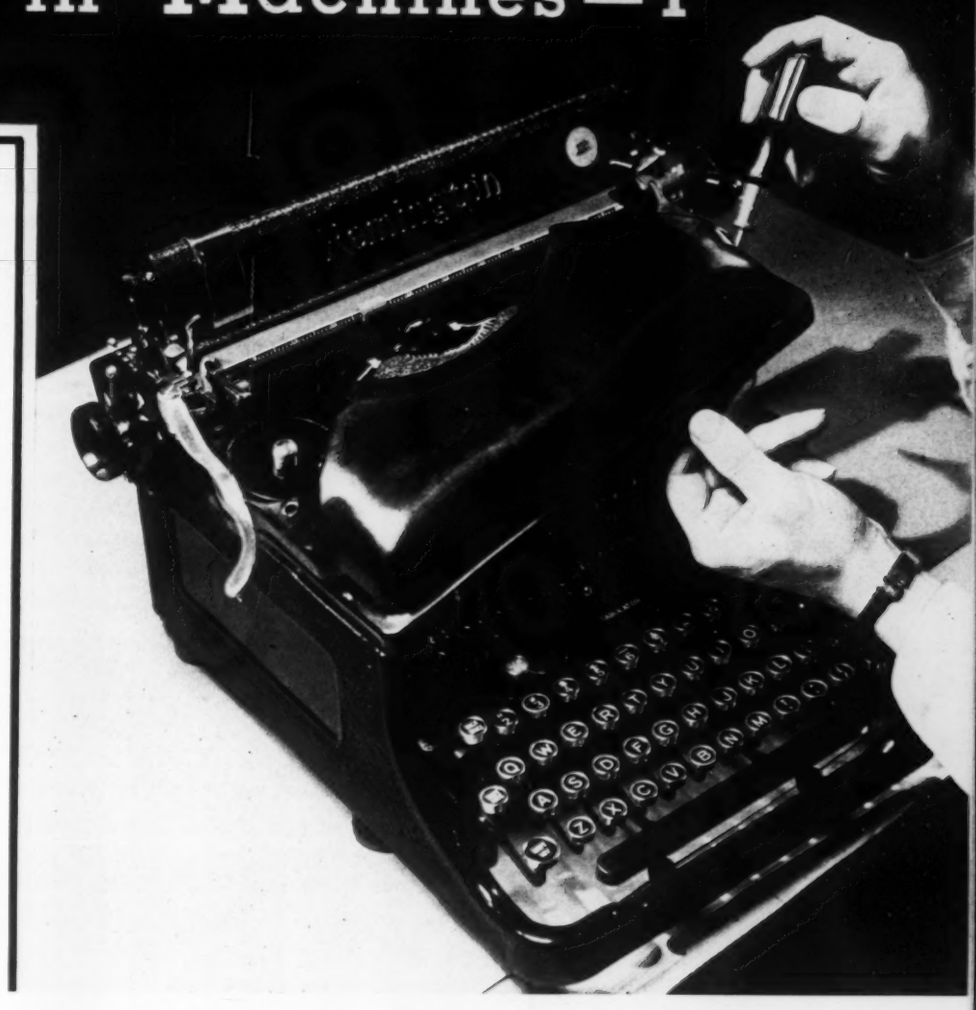

Fig. 1—Housing which has lightness, high polish and resistance to corrosion is provided by molded plastic material

SELECTION of materials to fulfill engineering design requirements was formerly limited to the more common structural metals and wood. The development of plastic materials demands more careful deliberation than in the past, as certain plastics offer superior properties and greater economies than were hitherto realized. Not only are many benefits possible by the more desirable properties of plastics, but also the entire outlook upon the exterior design of the product is altered. New color schemes and smooth, durable finishes lend attractiveness and appeal to exterior design, and have inspired designers to even greater efforts.

Cellulose derivatives, synthetic resins, proteins, rubbers and natural resins comprise the great majority of plastic materials. In Table I are listed the specific qualities of each group of plastic materials which make that group desirable for engineering purposes. In addition, these organic materials are important in the formulation of finishing compounds such as enamels, lacquers, varnishes, and lacquer enamels. Their role in the finishing field, however, though highly significant to engineering design, will not be discussed in this article.

Plastics in their solid state are of more immediate interest as high strength, light weight and excellent chemical resisting properties are in evidence. These materials may be divided into two basic groups: Thermoplastic and thermosetting. The former group is softened by heat; the latter polymerizes under heat and pressure into a hard, infusible state. An application of a thermosetting plastic is shown in *Fig.* 1, a molded typewriter housing.

The majority of plastic applications to the design of

machines is confined to the thermosetting resins: Phenol-formaldehyde and urea-formaldehyde. More specialized purposes are served by the cellulose derivatives, acrylic resins, soya bean resins, and rubber compounds. A brief description follows of the plastic types which have the greatest importance to the mechanical engineer.

PHENOL-FORMALDEHYDE—Under certain conditions phenol (carbolic acid) and formaldehyde will combine chemically to form a synthetic resin. With the application of heat and pressure, the resin forms a hard, infusible mass. The wide variety of properties exhibited by the phenolic plastic materials depends upon the nature of the filler employed. Wood flour, organic fibers, woven textiles, or papers are common organic fillers. Inorganic fillers include graphite, mica, asbestos, minerals and clay. These fillers impart special characteristics as heat resistance, high dielectric strength, impact strength, better molding qualities, or improved chemical resistance. Custom molders are always willing to make recommendations for the molding powders that will give the best results under certain conditions.

Functions of Laminated Plastics

The plastics are likewise available as laminated sheets and tubes comprised of parallel layers of paper sheets or woven fabrics thoroughly impregnated with the resin. The characteristics and functions of this group of materials are distinct from the molded types. These differences will be brought out more clearly later, in analyzing the plastic requirements of the machine designer. At slightly greater cost, the cast phenol-formaldehyde resins are available in a wide variety of attractive colors. Typical molded phenol resins are: Durrez, Bakelite, Resinox; laminated resins: Synthane, Insurok, Micarta and Textolite, and cast phenol resins: Catalin and Marblette.

UREA-FORMALDEHYDE—Urea-formaldehyde resin, of more recent development than phenol-formaldehyde is noteworthy as a molding material capable of giving beautiful color effects. Though their cost is usually greater than the phenol resins, the sales appeal of the delicate, translucent, pastel shades creates a large demand for them. The molded urea resins are light fast, and obtainable in all colors. Cleanliness in their manufacture is imperative, as minute dark impurities are emphasized in a translucent background. Consequently it is sometimes more expedient to mold them in a mottled color finish. More exact tolerances of pressure and temperature are required to mold the urea resins than the phenol resins, and because of the low thermal conductivity of the urea resin molding powder, urea pieces with heavy cross-sections are difficult to produce. Urea formaldehyde is available in cast and laminated form, though its application in these forms is limited. Its greatest value is for molded exterior housings. Typical among the molded urea resins are: Plaskon, Beetle, and Unyte.

CELLULOSE ACETATE—The most widely used of the thermoplastic compounds is cellulose acetate. It has replaced the older cellulose nitrate (celluloid), in many instances, because of its lack of flammability. Cellulose acetate molding powders are noted for the tough and resilient products they produce. In general, thinner wall sections may be molded with cellulose acetate than with the other molding compounds. It will however, soften at a lower temperature than other plastic materials, and at very low temperatures become quite brittle. At normal temperatures its resiliency permits riveting metal parts in place without the

TABLE I

TYPICAL PLASTIC MATERIALS

Type of Plastic	Outstanding Engineering Properties	AVERAGE CHARACTERISTICS Tensile Strength P. S. I.	Specific Gravity	Modulus of Elasticity P. S. I.	Water Absorption % in 24 hrs.
Cellulose Acetate (Thermoplastic)	Excellent molding qualities, tough, resilient; available in transparent colors	4,000- 6,000	1.27-1.37	145,000 to 200,000	3.0-4.0
Phenol-Formaldehyde (Thermosetting) Molded					
Wood flour filler	Good electrical properties and molding qualities	6,000-10,000	1.34-1.52	1,000,000 to 2,000,000	.20-.60
Shredded fabric filler	Highest impact strength for molded parts	6,000- 8,000	1.34-1.40	1,000,000 to 3,000,000	1.0-3.0
Asbestos filler	High temperatures (450° F.) low water absorption	5,000-10,000	1.60-2.0	1,000,000 to 2,000,000	.01-.15
Phenol-Formaldehyde (Thermosetting) Laminated	Highest strength and shock resistance	8,000-12,500	1.30-1.40	800,000 to 2,500,000	1.0-2.5
Urea Formaldehyde (Thermosetting) Molded	Attractive, light fast colors; resistance to food acids	5,000-13,000	1.48-1.50	1,200,000 to 1,600,000	.40-3.0
Acrylic Resin (Thermoplastic)	Water-white transparency	7,000-10,000	1.17-1.20	400,000	.17
Glyceryl-Phthalate (Thermoplastic)	Low water absorption, good electrical properties	10,000-12,000	.....	High	Negligible

danger of cracking the material. From the viewpoint of appearance, cellulose acetate has another advantage: It may be molded in a number of transparent colors. When highly stressed it loses its transparency.

COLD MOLDED RESINS—Cold molding differs from the process for producing thermosetting resins, inasmuch as the molds are not heated and cooled, but the cold molded products are heat treated afterward. The molds are less expensive, and high production rates are obtainable. Though their strength and shock resistance is considerably below that of the other resins, cold molded plastics will withstand higher temperatures. There are three main groups of cold molded materials: Those using bitumen binders, cement binders, and resin binders. The bitumen binders are the most common and the least expensive. They are used in the construction of a number of electrical parts and appliances, such as appliance plugs, receptacles and switch parts. The surface appearance of these products is rather unattractive. Manufacturers are inclined to compound their own cold molded materials, contrary to the procedure for the resins, where the materials are purchased already mixed.

New Materials Are Developed

SOYA-BEAN, ACRYLIC, GLYCERYL-PATHALATE AND CASEIN RESINS—A few additional resins, though limited in their applications to machines at present, are promising increased utility. The soya-bean is a specialty of the Ford Motor Co. This material in resinous form is combined with phenolics to form the ignition coil case, water pump impeller and distributor parts. Casein resins are in the process of development, wherein sour milk is treated to obtain the colloidal suspension, which serves as the basis for a tough, horny, resin. Glyceryl-phthalate in solid, resinous form is a product of General Electric Co. By controlling the plasticizer content, any degree of flexibility is obtained. Finally, acrylic resins, recently available in molding powder form, introduce a water-white, transparent, nonbrittle material, ideal for transparent covers.

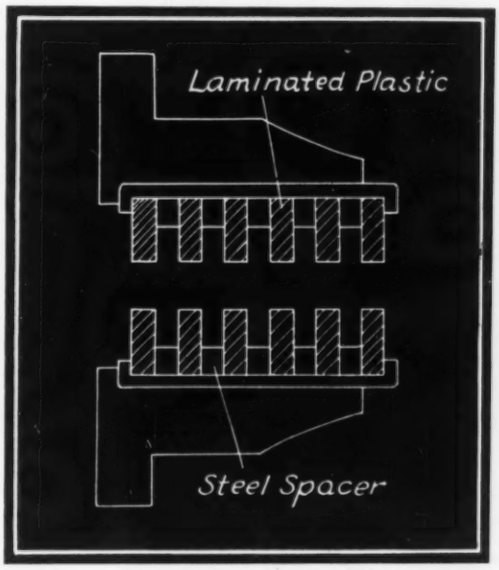

Fig. 2—For small high-speed machines, plastic bearings with gaps for lubricant are used satisfactorily

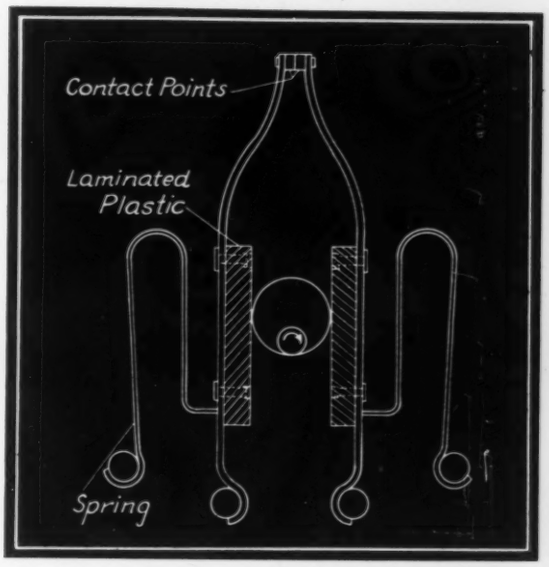

Fig. 3—High impact resistance of laminated plastic makes it ideal for make and break electrical contact device

PHENOL RESIN LAMINATED SHEETS—Laminated sheet stocks in any size from .02 to 12 inches are commercially available with various grades of linen, canvas or paper laminations. The highest strength characteristics are offered by the linen and canvas laminated plastics which have been standardized by a number of leading manufacturers.

A wide variety of intricate punchings and machine parts are possible by the use of a phenol resin laminated plastic. The gears and the bearings are quite in evidence. The advantages of laminated plastic gears, pinions, and bearings have been known for a long time and there are a number of instances where they have replaced metallic parts with appreciable success. The ability of a laminated plastic gear or pinion to absorb water or oil is a fortunate occurrence, as parts difficult to lubricate may rely upon the lubricant absorbed by the plastic. Moreover, the laminated plastic offers a low coefficient of friction. In the course of time, however, if additional lubricant is not added, the shaft may be scored.

Increased lubricant capacity is realized in the bearing sketched in *Fig.* 2, which depicts a bearing used upon a high-speed machine. Laminated plastic washers are stacked with shorter steel washers and assembled in a brass tube. The other end of the tube is spun over and the washers reamed to the desired

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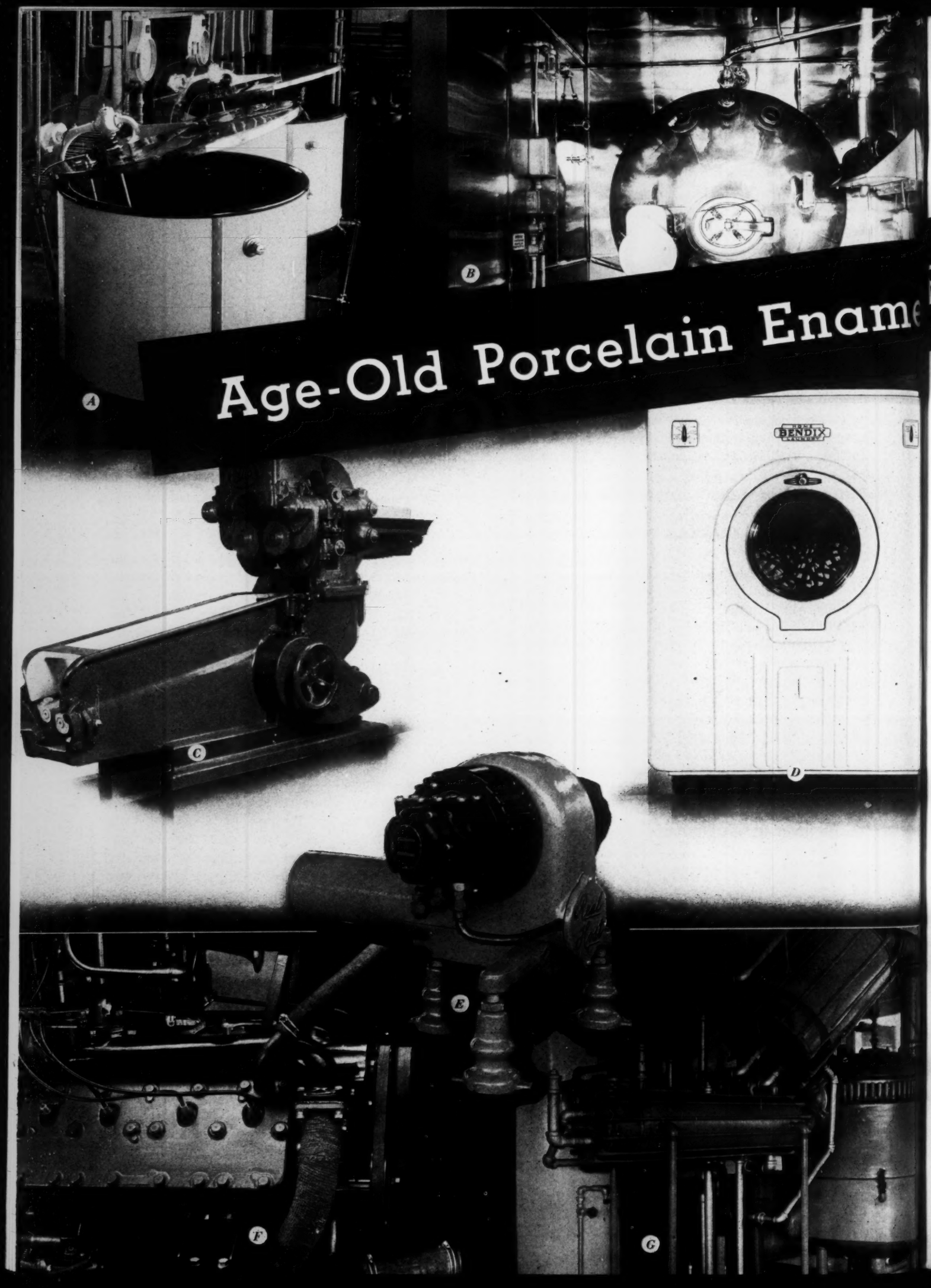
Age-Old Porcelain Enam
A
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Finds New Machine Uses

By R. M. King

Technical Director, Porcelain Enamel Institute

PORCELAIN enamel has graduated through the centuries from a material used only for ornamentation to one that finds a multitude of practical applications. Seventeen hundred years before Christ, Egyptian craftsmen were making jewelry covered with a brilliantly colored, glazed material which we now know as porcelain enamel. Although the art of deposition and fusing glass to metal—for that is what porcelain enameling is—was known so long ago, it is only in the past few years that the development in enameling has made it eminently suitable for application to machines.

Besides its beautiful and lasting finish, the protective properties of porcelain enamel make it ideal for metal parts. It will resist both corrosion and abrasion, hence it can be used where wear is severe and in contact with chemicals. It should be kept in mind, however, that enamels vary considerably in their degree of chemcal and abrasive resistance and should be specified for the purpose at hand.

Few of us, unless we live in particularly primeval surroundings, go more than a few hours without enjoying the benefits of porcelain enameled products. In the kitchen it is applied to mixing machines, refrigerators, stoves and most food containers. Other household machines, such as the washing machine, *Fig.* 1*D*, are finished in porcelain enamel. Earliest applications of this material in the home were to plumbing fixtures which include wash basins, soap dishes, bath tubs, etc.

The great value of porcelain as a finish is that it is inorganic. It is definitely a mineral substance made up of a properly proportioned mixture of silica, borax, soda, zinc oxides and several other substances in small parts. These ingredients are first reduced to a molten mass in a high temperature smelter. From the smelter the material is broken into a powdered form, commonly known as "frit," in which state it is applied uniformly to metal surfaces. Then it is fired to the base

Fig. 1—Many uses of porcelain enamel as a finish for machine parts are seen on page at left. In A, B and C porcelain enamel is used to line tanks handling corrosive liquids or those which might be contaminated by metallic contact. Trough of the corn husking machine, C, is enameled, as are exhaust manifolds of auto engine, F. Washing machine, D, and oil burner, E, are both finished in porcelain enamel

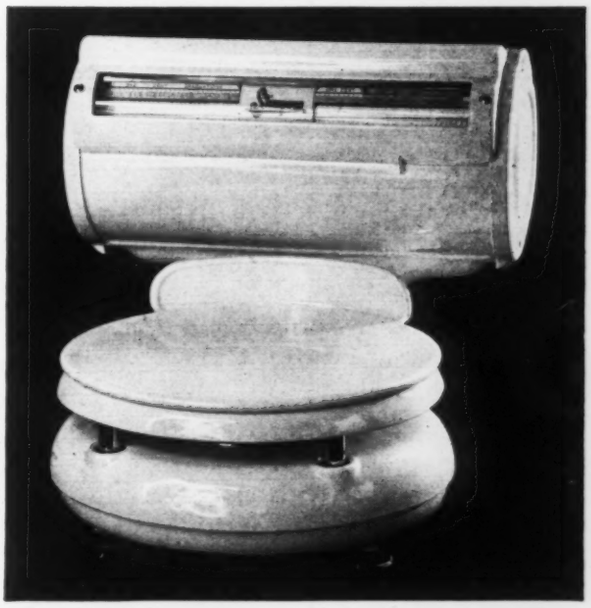
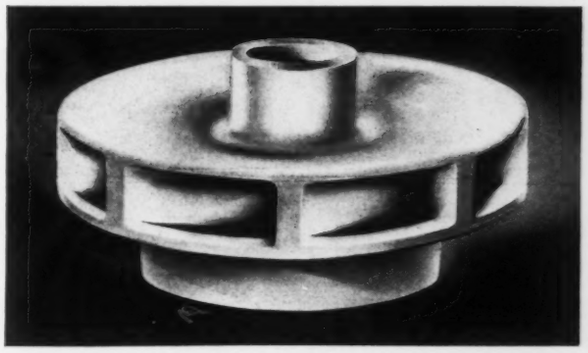


Fig. 2—Food weighing scale is made exceptionally sanitary by complete finish of porcelain enamel

Fig. 3—Porcelain enamel completely covers impeller making it suitable for use with corrosive solutions



metal at a heat of 1450 to 1550 degrees Fahr. Of course, for different metals and different grades of porcelain the process of enameling is slightly different, but basically all porcelain enameling depends upon high temperatures which fuse the frit to the metal to make a smooth, glazed, rock hard surface.

Because of its hard, enduring, nonporous surface, resistance to corrosion, transparence if desired and availability in colors, porcelain is finding applications in many different types of machines. *Fig.* 1 depicts a variety of machines and equipment which utilize porcelain enamel. Among the most recent applications of this material is for the lining of the inner wall of impellers for deep well pumps. The cutting action of sand and the corrosive action of water have raised a serious problem in the use and maintenance of such pumps. Furthermore, in the manufacture of impellers and bowls, it is difficult to procure smooth, wear-resisting surfaces. In the case of cast iron pumps the galvanic action is often so severe as to cause rapid disintegration of the exposed parts. By the use of bronze impellers these difficulties have in numerous cases been overcome. After a considerable amount of experimental work several companies have succeeded in applying porcelain enamel to pump parts so that all areas are uniformly covered. A cast iron impeller porcelain-enameled is shown in *Fig.* 3.

Advantages gained by this enamel coating are (1) Increased efficiency because of lower frictional losses in the pump, (2) Maintenance of high efficiency for long period because of decreased wear, and (3) Porcelain enamel coating acts as insulator against corrosion or electrolysis and is acid resisting.

Little Friction on Porcelain

Where there is movement of materials of any kind over metal surfaces, porcelain enamel provides a glass-hard, smooth, slippery surface which will not only reduce friction, but will lengthen life of equipment to which it is applied. These properties of porcelain enamel find application in the coating of conveyor rollers and coal chutes. In the Tuc corn husking machine, *Fig.* 1*C*, the corn feeding trough is porcelain-lined. Contamination of corn is avoided, trough is easily cleaned and friction is reduced to a minimum.

Diesel engines are prone to exhaust fumes which are corrosive to hot exhaust pipes and mufflers. To combat this these parts have been porcelain enameled in several instances. For a number of years some of the higher priced automobiles have used porcelain covered manifolds, principally for appearance, but also to stop rusting and flaking of the manifold. *Fig.* 1*F* shows a Cadillac engine provided with porcelain finished manifolds.

When it was found that certain metal strips in combination were suitable for high temperature thermometers, the problem of obtaining a dial finish which would withstand the high temperatures was solved by porcelain enamel. The light reflecting qualities, ease of cleaning, rust resistance and durability were also factors in the adoption of this finish for thermometer dials and scales. Today not only thermometer dials, but dials for all types of appliances and instruments may be finished with porcelain enamel to give them neatness, utility and permanency.

The finishing of textile guides offers another application for the smoothness and wear-resisting qualities of porcelain enamel. Threads pass easily over guides finished with this smooth, hard surface, and maintenance of such parts is considerably reduced.

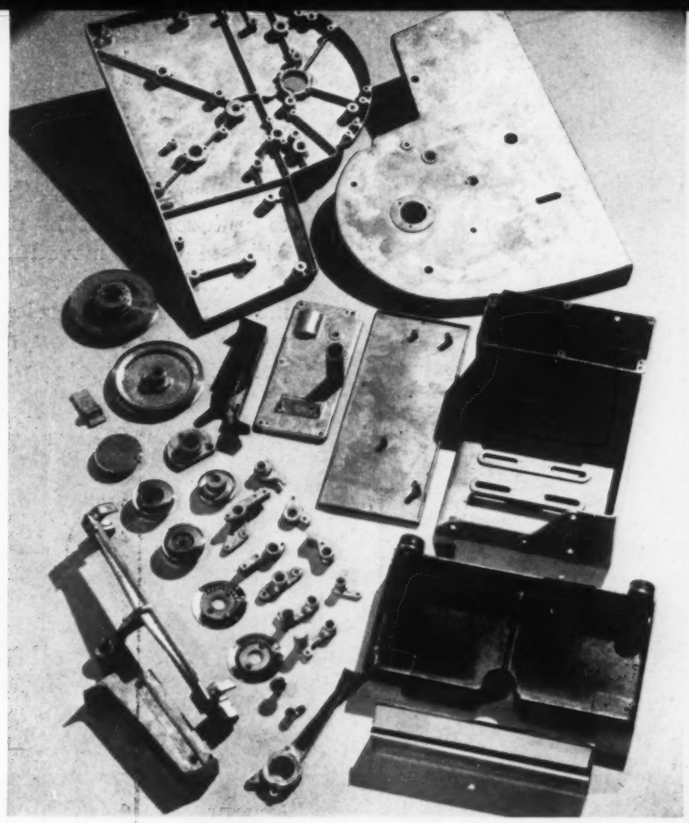
Parts Designed for Enameling

In any enameling operation, shape, thickness, angles and projections must be considered. Machine parts which are to be enameled should be designed with this treatment in view. Corners should be well rounded to heat uniformly, otherwise part of the enamel finish will be thoroughly baked when the rest is not fired enough. The amount of carbon in the metal has a direct bearing on the ease with which the frit is applied and irons and steel must be comparatively pure, free of silicon, manganese, phosphorus and sulphur.

No article on the special uses of porcelain enamel is complete without a consideration of porcelain-enamel-lined chemical equipment, such as storage tanks and vats for manufacturing corrosive liquids. Shown in *A*, *B*, and *G* of *Fig.* 1 are three different applications of porcelain for this type of equipment. Large milk trucks have tanks glass-lined or finished with porcelain to prevent metallic contamination of the milk and acid corrosion of the metal. The material is used extensively with brewing equipment which would otherwise be attacked by alcoholic liquids.

Porcelain Finish Gives Good Appearance

If for no other reason than appearance alone, many machines might well be porcelain-enameled. *Fig.* 2 is of a small weighing machine which has been completely finished in enamel. Its glistening, white surface gives a sanitary atmosphere to any store or meat market where it might be used. Of course, other purposes are served by such a finish. It is easily cleaned, the enamel does not deteriorate with age, there is no food contamination and a porcelain finish harmonizes with tile or glazed surfaces which are frequently used in stores. Even though porcelain enamel as a product is as ancient as Confucius its comparatively recent development as a finish makes it as modern as tomorrow. Engineers will find it a material which will dress up, preserve and increase the efficiency of many machines or parts.



Utilizing Die Castings to Advantage

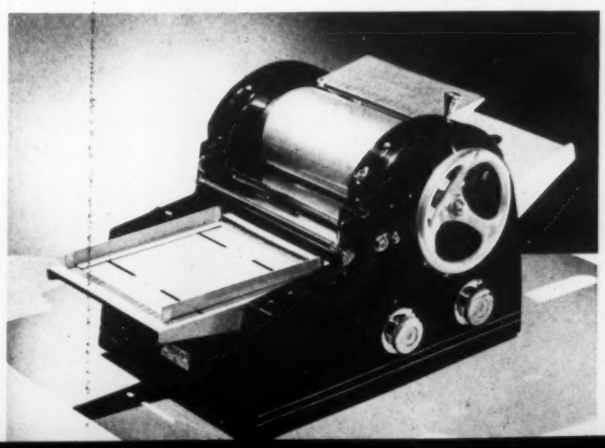
RECOGNIZING the present trend in office equipment towards compactness, conveniently-positioned controls, sturdiness and attractive style, engineers of Ditto company have designed a motor-driven rotary speed duplicator well worthy of a second look on the part of machine designers. Shrewd selection of materials and simplified mechanisms have eliminated many parts used in earlier models. Production operations are reduced to a minimum, keeping down the cost of the machine.

Accountable for much of the modern styling found in the duplicator is the use of zinc alloy die castings. Thirty-nine such castings are used for structural, decorative and mechanical parts constituting 58 per cent by weight (42 pounds) of the complete machine. The die castings, as can be seen in the illustration at the top of the page, vary considerably in size and shape. The smallest weighs but .014 pounds and the largest nine pounds.

Two die-cast frames carry integral bosses, lugs and cored holes to simplify assembly and position the parts. Except for drilling and tapping holes, little machining is necessary on the castings. Surfaces are smooth, free of inclusions and all small detail including thin sections and flanges of wheels are—"as cast."

Operation of the duplicator has been refined and it is practically noiseless when running. Controls are so placed as to be convenient yet not protrude and interfere with general styling of the machine. Inking mechanism is well protected to prevent operator from soiling hands or smudging prints.

Black, baked enamel and chromium-plated hardware give the machine an attractive and durable finish. The large base at the right of the upper illustration is sprayed with a copper solution to resist corrosive attack from printing liquids which are contained in a small tank at one end of the casting.

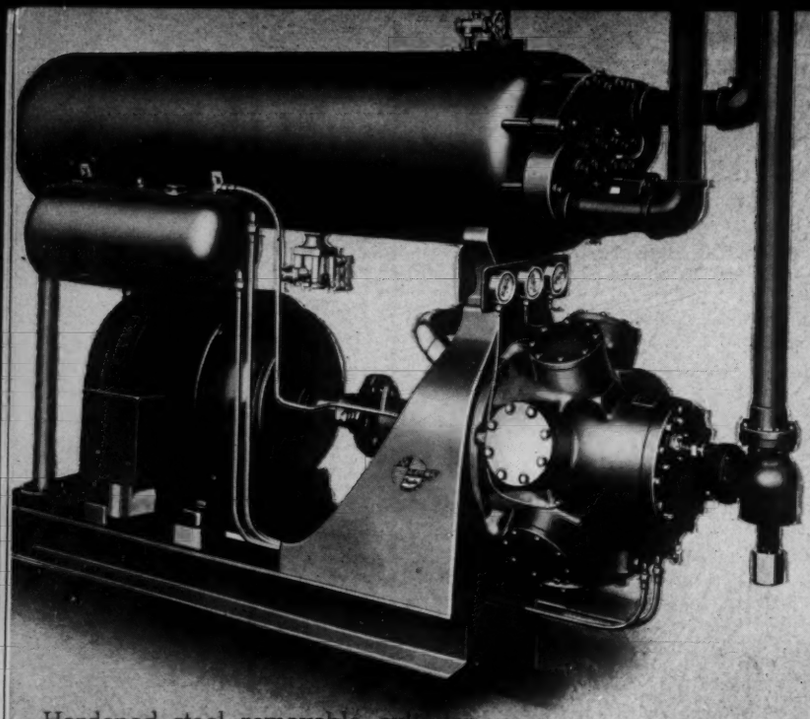


Top—Die castings vary in size from large side panels to tiny levers and wheels

Left—Redesigned duplicator possesses neat and finished appearance. Controls are positioned for easy operation

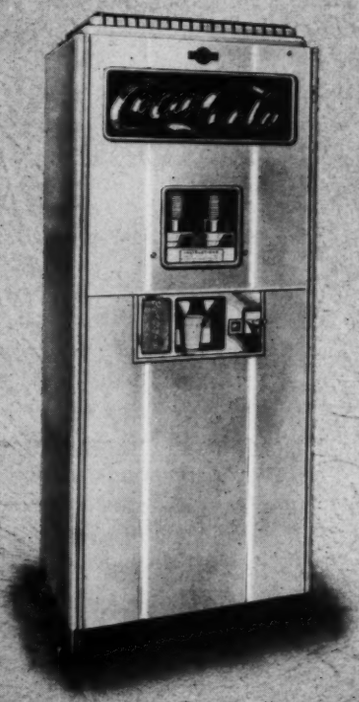
Design Features In New Machines

With Special Reference to Choice of Materi



Hardened steel removable cylinder liners on the Airtemp refrigeration compressor, above, give longer life and facilitate overhaul of the unit. Radial construction of compressor reduces vibration and saves weight

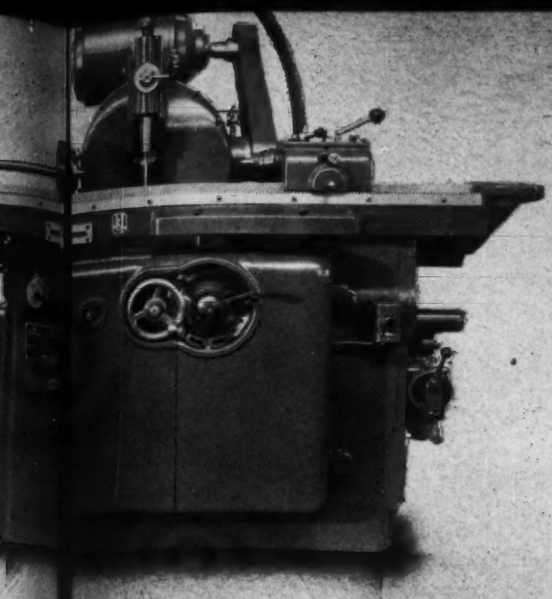
Wheelhead on the Jones & Lamson automatic thread-grinding machine, right, is made of aluminum to reduce weight in order that slide may be moved backward and forward freely. Graduated motor rheostat indicates spindle revolutions and allows easy compensation for grinding wheel wear



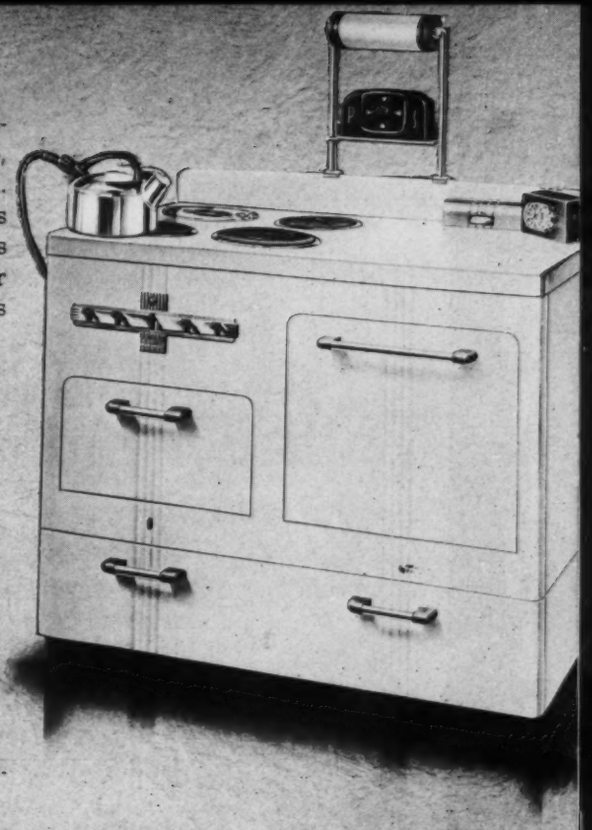
Vibration in the Masterdrink machine, right, is reduced by using flexible shaft or belt for all power connections. As carbon dioxide gas becomes part of drinking mixture, stainless steel tubing and containers are used to resist any corrosion from the carbonated liquid

Large rubber tires feature the Graham-Bradley tractor, below, and enable it to travel at 25 miles per hour in high gear. Tires may be loaded with 250 pounds of water for extra traction. Air cleaner, oil and gas filters are standard equipment

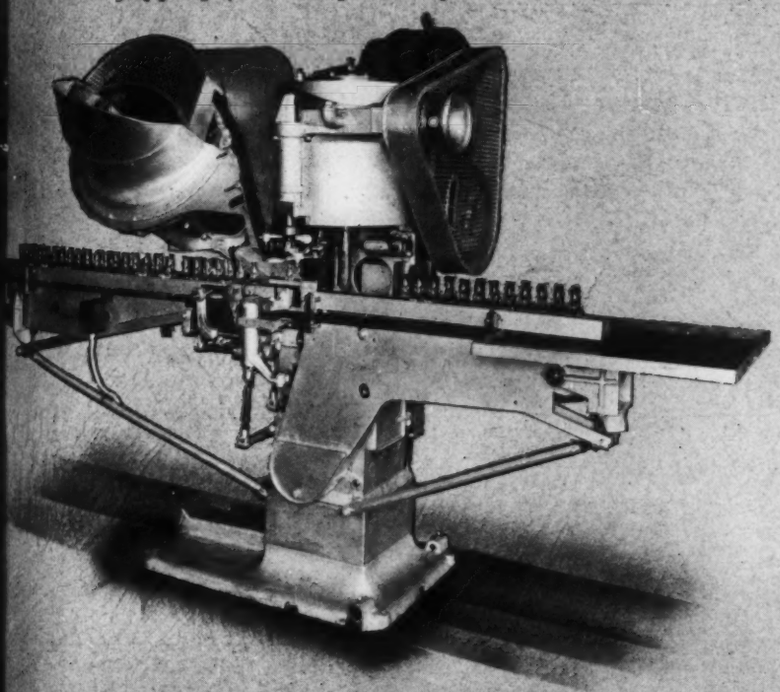
Stainless steel mix tank equipped with stainless steel agitator provides ready supply of mix for Cherry-Burrell instant ice cream freezer, right. Five-horsepower motor driving ammonia compressor is enclosed in base, but is readily accessible through cast aluminum doors



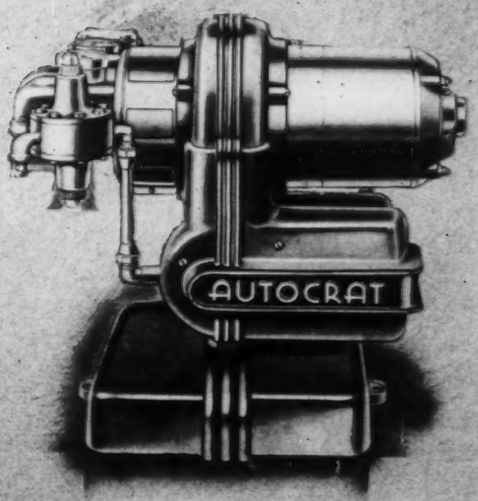
Lustrous, permanent finish is obtained on the Electro-master range, right, with porcelain enamel. Designed by Wilbur Henry Adams the range includes innovations such as a plastic enclosed timer which controls oven and burners

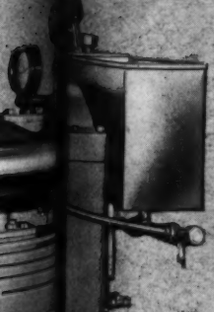


Cams in the Pneumatic Scale capping machine, below, are made of a special cam iron having high tensile strength and great wear resistance. Hardened tool steel is employed for the cap gripping jaws to give long life



Pressure regulating valve in the Autocrat oil burner, below, has been reduced in size and made more attractive by use of a zinc die casting. Motor, fan and pump are single assembly, carefully machined and tested for mechanical balance for elimination of all vibration





Galvannealed sheet steel in body of Seagrave sedan-type pumping engine, right, prevents damage from corrosive firefighting solutions. Body framework is constructed of low carbon steel tubing, arc welded together. Machine is capable of delivering 1000 gallons of water per minute

Ever-Increasing Range of Materials Demands Continuous Attention

BELIEVE it or not, the directory of materials included with this issue contains as many as 1053 individual listings of names and grades of metallic and nonmetallic materials! Not so many, one might say, but when consideration is given to the fact that every one of these listings is selected because the material it describes has actual or potential use in the design of machinery the number becomes, to say the least, pretentious.

Such a listing of items indicates to the full, among other things, the difficulties with which the designer is faced in selecting the most suitable materials for the various parts of his machine. It can well be understood how he often reaches his wits' end in weighing the pros and cons. But, hard though the selection may seem at times, there is little or no excuse for failure of parts with a range of choice so great. Even demand of the machinery builder has been met —in many cases predetermined—by materials producers, and new additions to the ranks of metallics and nonmetallics are being made practically every day.

To the alert engineer charged with responsibility for design this wide and ever-increasing range of selection is encouraging, particularly if he feels he can keep abreast of the most recent developments. It is to him that the Fifth Edition of MACHINE DESIGN'S Directory of Materials, containing the latest available information, is dedicated.

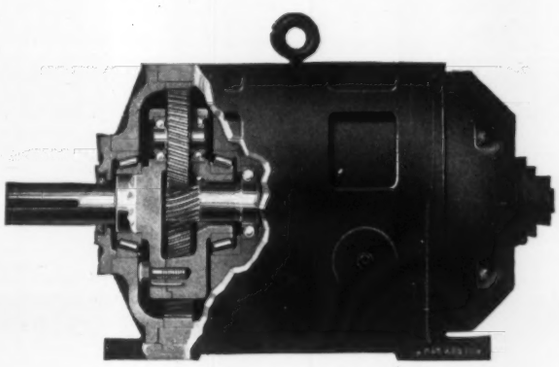
• • •

Engineering Training

RESULTS of a survey made by Professor Eidmann of Columbia university regarding employment of graduate engineers are significant in that they prove two things, among others, of vital importance to all of us: That most causes of failure on the part of young graduates are due—not to lack of knowledge of engineering matters—but to the inability to get along with associates; and that post-graduate work or specialized courses are often a detriment rather than a help in obtaining satisfactory employment, young men who have taken fundamental four-year courses being preferred except by a few companies where highly specialized development is carried on.

College training is unquestionably becoming more and more necessary in engineering work. But that it can be overdone is evident. If in the struggle to obtain intensive engineering knowledge the value of establishing equitable human relations is discounted or lost sight of entirely, the engineering training can well turn out to be less than useless.

STRUCTURAL *Simplicity* SLASHES MAINTENANCE COST



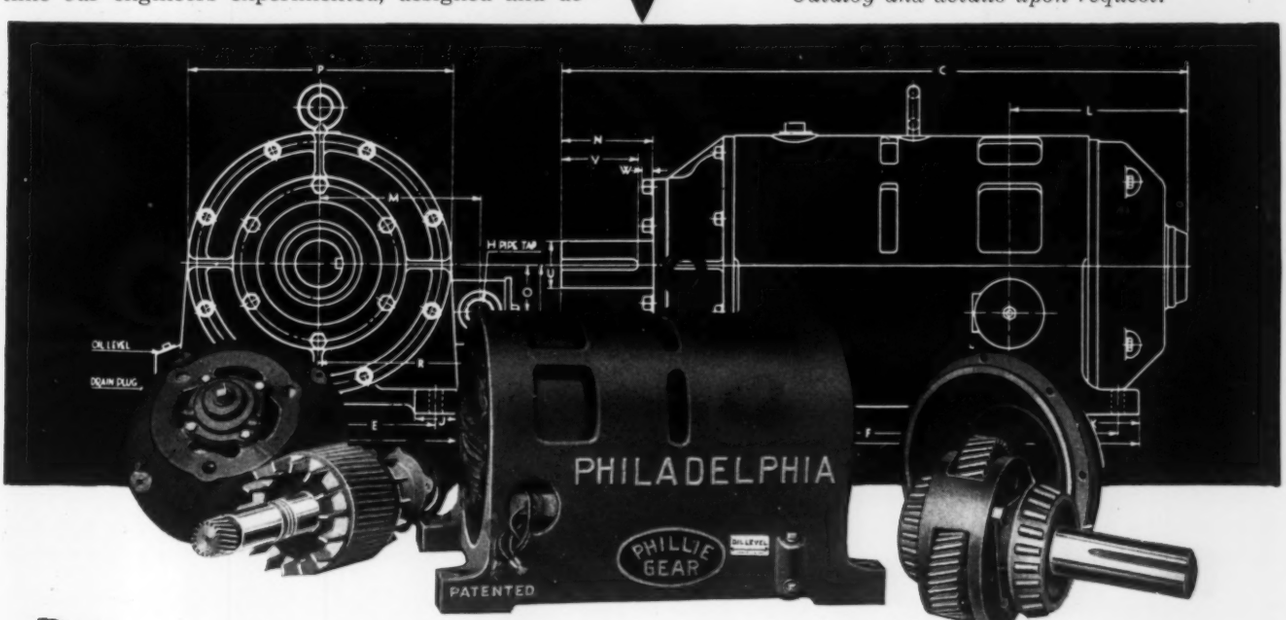
A cutaway view of HS Open Type MotoReduceR

Not over 5 years ago, the idea of an efficient, compact, self-contained combination of Motor and Speed Reduction Unit was treated lightly by industrial buyers, and, no doubt, rightly so. But during that time our engineers experimented, designed and developed the well-known Philadelphia MotoReduceR which, today, is used by the hundreds in practically all lines of American Industry. And, we have been told by countless Engineers that the *structural simplicity* of the MotoReduceR does slash maintenance costs. (Even the most cursory glance at the dismantled MotoReduceR below will convince you of this.)

Consider, too, if you will, the other advantages of the MotoReduceR, such as: *Built-in construction* (one casing) which does away with base plates and flexible coupling; *Ease of installation; Silent, fool-proof operation; Cleanliness; Portability; Easy access to working parts; Neat appearance; Space Saving; Lack of attention required; Perfect Balance* (no overhung parts); *Imperviousness* to dust, dirt, fumes and moisture.

Yes, just consider all these *advantages,* and you will understand why the Philadelphia MotoReduceR is a leader.

Catalog and details upon request.



PHILADELPHIA

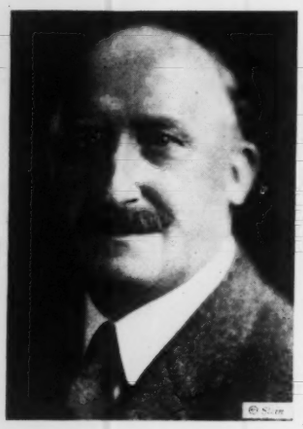
MOTOREDUCER

PHILADELPHIA GEAR WORKS

Industrial Gears and Speed Reducers

ERIE AVENUE AND G STREET, PHILADELPHIA

MEN of MACHINES



P. C. DAY

FALK CORP., Milwaukee, has advanced P. C. Day to the vice presidency. Mr. Day, who has been connected with the company as an engineering executive for more than 27 years, will continue to be its chief engineer.

Born in Kent, England, in 1874, Mr. Day graduated from Central Technical college, South Kensington, London, in 1894. After leaving college he was engaged in the manufacture of calcium carbide and in electrometallurgical work. In 1905 he joined the Power Plant Co., and for several years was in charge of its West Drayton gear works, becoming recognized as an authority in design and manufacture of finer types of gearing. When he joined the Falk organization in 1910 he was one of the pioneers in helical and herringbone gearing in the United States.

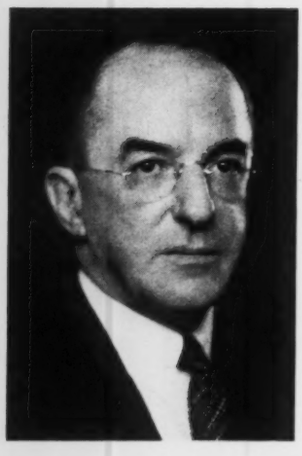
• • •

H. M. WILCOX

AS MANAGER of its recently organized new products division, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has appointed H. M. Wilcox. He formerly was vice president of Electrical Research Products Inc., a subsidiary of Western Electric Co., engaged in development and promotion of American Telephone & Telegraph Co. patents outside the telephone field, as for instance sound in motion pictures.

Mr. Wilcox, who was born at Pittsburgh in 1882, was educated at Princeton and at the Massachusetts Institute of Technology. Following several years experience in drafting, estimating and executive work, he became, in 1909, staff engineer with Miller-Franklyn Co., industrial engineers. From 1914 to 1926 he was industrial engineer for the Winchester Repeating Arms Co., and in that position had wide experience in providing new products for manufacturing.

• • •



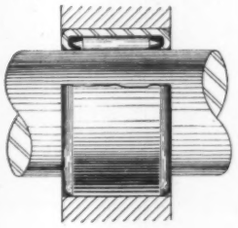
H. P. HAMMOND

DR. H. P. HAMMOND, who was head of the department of civil engineering at the Polytechnic Institute of Brooklyn since 1927, is now dean of the school of engineering at the Pennsylvania State college.

Harry Parker Hammond was born at Asbury Park, N. J., in 1884, attended school at Atlantic Highlands and Wilmington, and in 1909 graduated from the University of Pennsylvania with the degree of Bachelor of Science in civil engineering. Subsequently he received from this university the degree of Civil Engineer; and from the Case School of Applied Science the honorary degree of Doctor of Engineering.

Dr. Hammond began his teaching career as an instructor in civil engineering at the University of Pennsylvania, two years later accepting a similar position at Lehigh. He joined the staff of the Polytechnic Institute

This new bearing promotes



Simplicity Of Design

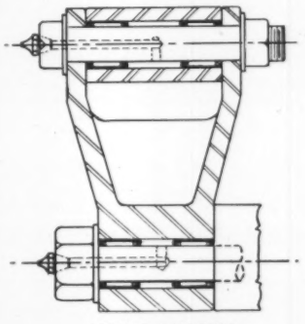
DIRECTLY CONTRIBUTES TO LOWER MATERIAL COST, ASSEMBLY AND PRODUCTION ECONOMIES

THE SIMPLICITY of the Torrington Needle Bearing itself is the chief factor in simplification of designs where this new bearing is employed.

For example, the Torrington Needle Bearing is a complete, self-contained anti-friction unit with but two components: the full complement of needle rollers and the retaining shell in which they are housed which also serves as the outer raceway. And, because of the relatively small diameter of the rollers and the thin, tough retaining shell, very small space is required for installation—often less than for a plain bushing. In addition, the unusually high radial load capacity of the Needle Bearing, due to the many linear inches of contact, makes it possible to carry heavier loads with smaller diameter shafts.

Minimum Housing Structure

The small space needed for installation and the unit construction of the Torrington Needle Bearing is such that only the simplest type of housing structure need be provided. A housing bore of proper dimensions to take the bearing is all that is required.



SPRING SHACKLE

Thus, smaller housings may be used with the consequent reduction in size, weight and cost of surrounding members.

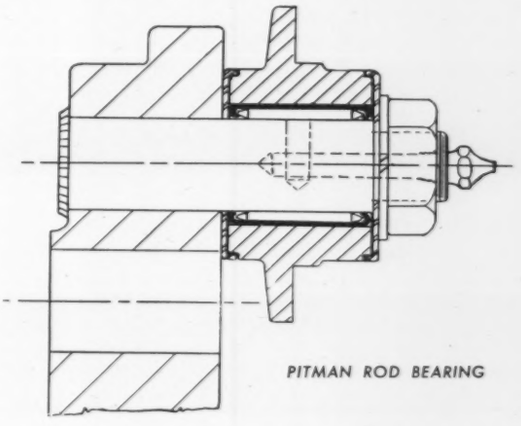
Another factor in design simplication is the efficient method of lubrication of the Torrington Needle Bearing. The retaining shell provides a natural reservoir for the lubricant and the clearance of .0025" between the turned-in lip and the shaft provides an effective seal. Therefore, in certain types of applications *no lubricating system* need be provided, for the bearing once packed with lubricant will require no further attention for a considerable period of time—in some cases for the life of the unit.

All of these factors contribute directly to simplification of design.

Low Cost A Factor

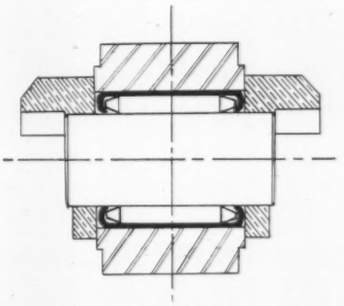
The Torrington Needle Bearing is a comparatively inexpensive anti-friction bearing. This also contributes indirectly to simplification of design problems. Coupled with direct savings in material costs, plus economies of installation and production, the low cost of the Torrington Needle Bearing makes it possible to use and secure the advantages of anti-friction bearings in applications where their use formerly was prohibited because of the cost factor.

The facilities of the Torrington Engineering Department are available to all interested in adapting the Torrington Needle Bearing to their products. Manufacturers are invited to consult our engineering staff on questions of the design and development of assemblies.



PITMAN ROD BEARING

Three typical applications where use of the Torrington Needle Bearing simplifies design.



SLIDE ROLLER

FEATURES OF THE TORRINGTON NEEDLE BEARING

Small Size **Ease of Installation**
Efficient Lubrication **Low Cost**
High Radial Load Capacity

Further information and data on the new Torrington Needle Bearing, the types and sizes available for immediate shipment from stocks, etc., available on request. Write for *Catalog No. 9*

•

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.

Branch Offices in all Principal Cities

TORRINGTON
NEEDLE BEARING

of Brooklyn in 1912, remaining there twenty-five years.

Dr. Hammond, a past president of the Society for the Promotion of Engineering Education, represents this organization on the Engineers Council for Professional Development. He is a member of the council's committee on engineering schools which is examining and accrediting engineering colleges of the United States.

♦ ♦ ♦

WAYNE Z. FRIEND has joined the development and research staff of the International Nickel Co., New York, and will devote his attention to technical problems involving use of corrosion-resisting materials.

♦ ♦ ♦

W. A. NEILL has been appointed manager of engineering and sales activities at the recently reopened Holyoke, Mass., plant of the Worthington Pump & Machinery Corp. Mr. Neill, formerly manager of the air tool and portable compressor division at Harrison, N. J., was educated at Leland Stanford university.

♦ ♦ ♦

R. M. FENTON, formerly chief engineer of the Newton Steel Co., and later connected with the Aetna-Standard Engineering Co., has been appointed chief engineer of the Otis Steel Co., Cleveland. Mr. Fenton succeeds C. CLARKE WALES who is now assistant general manager of Algona Steel Corp., Sault Ste Marie, Ont.

♦ ♦ ♦

HERBERT C. BEHRENS, assistant chief engineer of the Duplex Printing Press Co., Battle Creek, Mich., has been made chief engineer and will have charge of all research, development and engineering activities.

♦ ♦ ♦

DR. HARRY A. SCHWARTZ, head of the research department of National Malleable & Steel Castings Co., Cleveland, has been appointed professorial lecturer in the metallurgy department of Case School.

♦ ♦ ♦

CHARLES H. KEENEY recently returned to the Connecticut Blower Co., Hartford, Conn., as general manager and chief engineer. For 18 years prior to 1928 he was connected with this company.

♦ ♦ ♦

RALPH L. WILSON, who has been metallurgical engineer of the Timken Steel & Tube division of Timken Roller Bearing Co. since 1928, has joined Climax Molybdenum Co. in the same capacity. He is a graduate of Lehigh university and served on the metallurgical staff of the United Alloy Steel Corp., and its successors, Central Alloy Steel Corp. previous to joining Timken.

♦ ♦ ♦

R. A. DE VLIEG, widely known automotive engineer, has been appointed general works manager, Nash Motors division, Nash-Kelvinator Corp., in charge of manufacturing at Kenosha, Racine and Milwaukee, Wis. Previous to this appointment, Mr. De Vlieg was an engineering executive of Kelvinator Corp., Detroit.

Obituaries

HERMAN DIEDERICHS, dean of the college of engineering, Cornell University, died at Clifton Springs, N. Y. on August 31, at the age of 63.

Professor Diederichs, who became dean about a year ago, had been connected with the college of engineering for nearly 40 years. Born in Germany, he came to the United States at the age of 14 and within four years had learned English, graduated from high school and won a New York state scholarship to Cornell where he graduated in 1897 with an M. E. degree. Despite the fact that he had in part to work his way through college, he combined success in athletics with outstanding scholarship—attaining the Sibley fellowship for graduate study.

Professor Diederichs was the first recipient of the John E. Sweet professorship in mechanical engineering at Cornell when it was established in 1928. The last of his many professional society activities were as chairman of the board of awards, and of the nominating committee, of the American Society of Mechanical Engineers, from which he received the Melville award in 1931.

♦ ♦ ♦

NOAK VICTOR HYBINETTE, 71 inventor of the electrolytic process bearing his name for refining nickel, died in Malerno, Italy, on Sept. 7. He was born in Falun, Sweden, and after establishing a reputation in the metallurgy of nickel in Norway, he came to the United States and was made general superintendent of Oxford Copper Co., Bayonne, N. J., now merged with International Nickel Co. After holding this position for 12 years, he was made chief metallurgist of the company, and in recent years he had been president of Hybnickel Alloys Co., Wilmington, Del., and Nicralumin Co., Jackson, Mich.

♦ ♦ ♦

WILLIAM A. JOHNSTON, professor emeritus of theoretical and applied mechanics at the Massachusetts Institute of Technology, died on Aug. 6 at the age of 68. He had been connected with M. I. T. since 1892 and was widely known as an authority on applied mechanics, statics and kinetics, and strength of materials.

AGAIN

UNBRAKO

steps ahead

with a New Idea!

Heretofore there has never been a positive way of locking a Set Screw; yet if it works loose there's no telling what may happen.

We licked the problem by simply knurling the two top threads of the "UNBRAKO", as shown.

This Knurling raises sharp prongs all around the edge of the thread which dig right into the threads of the tapped hole when the "UNBRAKO" is being tightened up, so it can't possibly work loose.

Tests have proven and our customers, who have already bought about 2,000,000 of them, corroborate that the "UNBRAKO" *Self-Locking Set* positively won't budge once it's tightened up.

Send for Free Sample

Fig. 1564
Pat. Applied for

This time it's

UNBRAKO

SELF-LOCKING HOLLOW SET SCREW

STANDARD PRESSED STEEL CO.

BRANCHES BOSTON DETROIT INDIANAPOLIS

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836

Noteworthy Patents

HYDRAULIC PRESS MANUFACTURING CO., Mount Gilead, O., is the assignee of patent No. 2,087,811, granted to Isaac Patrick on improvements to heavy duty presses of hydraulic type.

One object of the improvement, as indicated by *Fig.* 1, is to provide means whereby the application of power to the platen is accomplished mechanically by means of a toggle connection, application of power to the toggle in turn being accomplished by a hydraulic cylinder and piston assembly. An important result of this combination is that the quickness of action of a mechanical press is attained, along with the smoothness and precison of one of hydraulic type.

The diagram, which is a front elevation partly in section, shows clearly how the hydraulic cylinder is built into the center of the top plate, with an effective outboard support for its piston assembly furnished by a rod which passes down into the body of the moving platen. The piston gives two-way action—a power stroke downward and a quick return stroke in an upward direction.

The two sets of toggles are symmetrically located at each side of the piston assembly so as to give balanced action and distribution of pressure over the

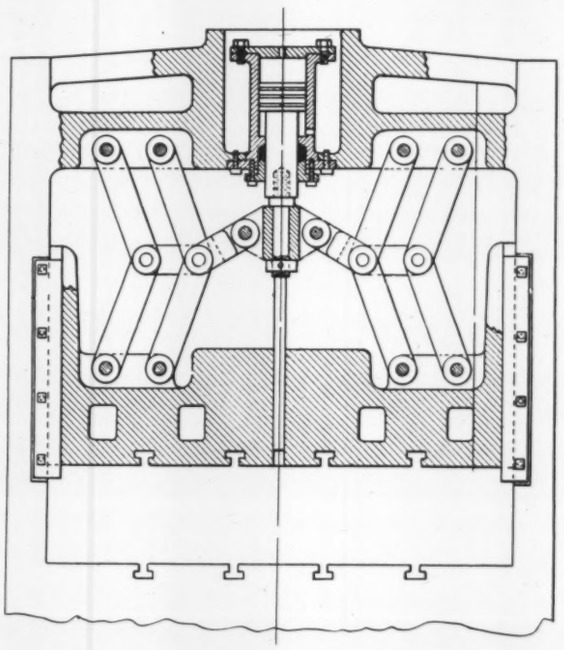
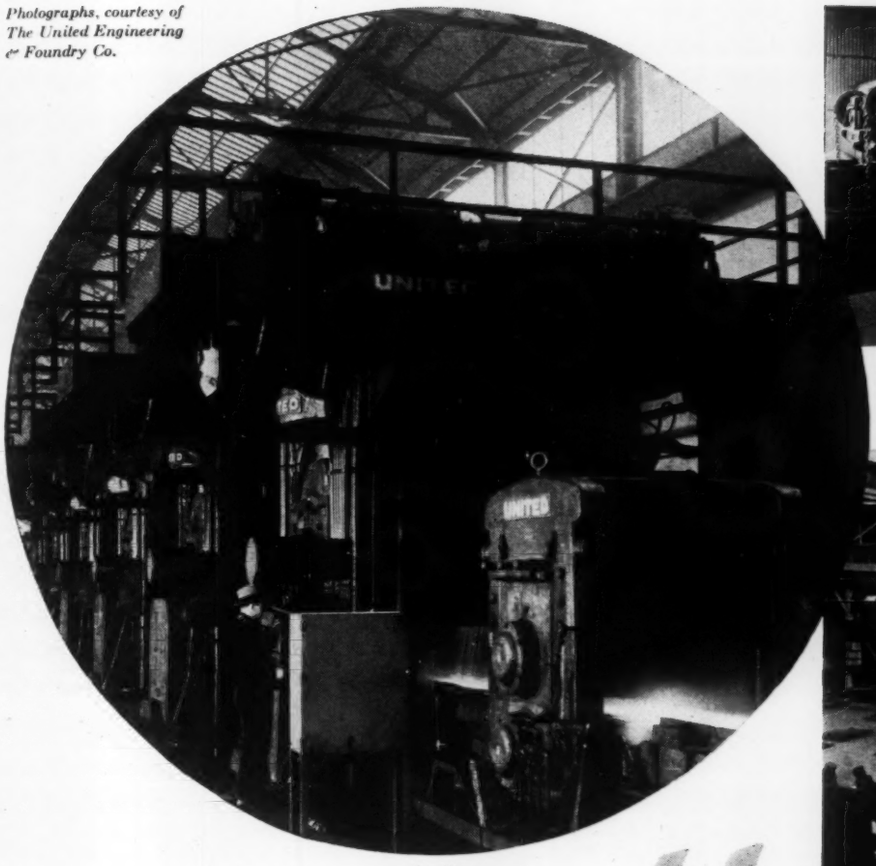
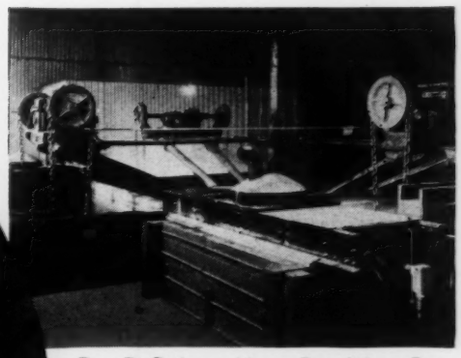


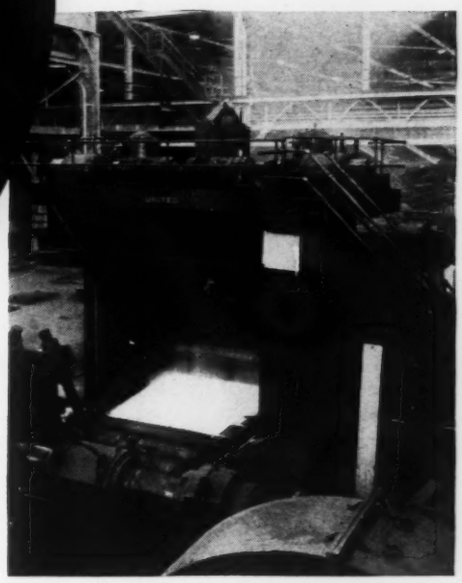
Fig. 1—*Advantages both of hydraulic and mechanical actuation are combined in this press*

Photographs, courtesy of The United Engineering & Foundry Co.





Four D. O. James Heavy Duty Worm Gear Reducers, size 357DW, ratio 1426 to 1, operating rotary coil pickler.



Large broadside mill equipped with D. O. James Reducers and Gears.

Big Stuff

126 D.O. James small worm gear reducers are very important parts of this continuous hot and cold strip mill... and this truly is, as we say, "*Big Stuff*."

For 50 years, the D. O. James Manufacturing Company have been making all types of gears and speed reducers, and whether it be "Big Stuff" or just one gear, we invite your inquiries.

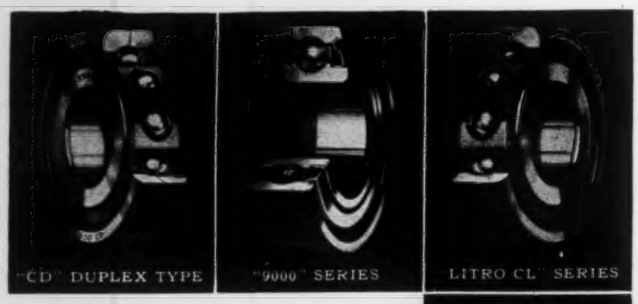
A thoroughly trained office and plant personnel welcome the opportunity of serving you. May we?

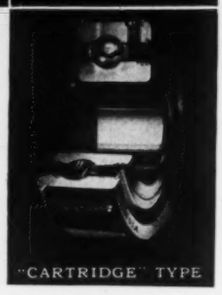
Rotary flying shear for a Russian steel mill. D. O. James Gears were used exclusively.

D. O. JAMES MANUFACTURING COMPANY, 1120 WEST MONROE STREET • CHICAGO, ILLINOIS

D.O.JAMES

FOR FIFTY YEARS—MAKERS OF EVERY TYPE OF SPEED REDUCER AND CUT GEAR





Blazing the Trail

TO SIMPLER DESIGN AND BETTER PERFORMANCE

As the years have passed, Industry has repeatedly had to conquer new frontiers. Changing economic conditions have called for better methods and better machines, which have created many new and perplexing problems for the machine designer. And where the anti-friction bearing has been involved, NORMA-HOFFMANN—"trail blazers" in so many of the great advances in bearing practice—has ever been ready to aid in the solution of these problems.

"CD" DUPLEX TYPE

Two-piece outer race, deep grooves and steep contact angle give *very large thrust capacity in either direction within single row width.*

"9000" SERIES

Made to felt seal widths but provides *larger grease capacity*, quicker starting, eliminating seal wear and resistance and loss of power.

"LITRO CL" ULTRA-PRECISION SERIES

Takes thrust in either direction, is equipped with phenol-impregnated linen composition retainer, is capable of operating at 50,000 RPM.

"CARTRIDGE" TYPE

100% *greater grease capacity* because of double row width; employs grease refilling plug and removable seal.

Pictured here are NORMA-HOFFMANN'S most recent contributions to bearing design—four PRECISION BEARINGS developed and produced at Industry's call for bearings that could be applied more quickly and economically, or that would meet unusual conditions of space or speed.

Write for the NORMA-HOFFMANN catalog, which describes 108 distinct series of PRECISION BEARINGS embracing over 3,000 catalogued sizes. Let our engineers work with you.

"NORMA-HOFFMANN"
PRECISION BEARINGS
BALL, ROLLER AND THRUST

NORMA-HOFFMANN BEARINGS CORP'N.
STAMFORD, CONNECTICUT, U. S. A.

platen. This last feature eliminates the warping effect of concentrated thrust and allows use of a lighter platen which cuts down inertia.

Heater Is "Fired" by Friction

FRICTIONAL heat ordinarily is a troublesome, though frequently unavoidable, by-product of the operation of a machine. However, in the case of a recent invention by Arthur Lazarus of St. Paul, Minn., frictional heat is the primary and the desired "product." This device, covered by patent No. 2,090,873, is depicted by *Fig.* 2. In the words of the inventor, it heat generated by a rotatable or moving member directly into a heating medium with a minimum of waste, so that the heating medium may be economically used for heating a room or building."

The device consists of a hollow cast iron cone with external heat-radiating fins on its body and a flange at its large end. This unit is bolted into a boiler or hot water tank. Within the bore of the hollow cone is mounted a conical motor-driven drum, shod with lignum vitae friction blocks. This internal cone or core is split and the two halves are pressed apart by internally-mounted coil springs, this providing a considerable degree of self-adjustment for wear.

At each end of the split cone, spring governor members are provided which tend to draw the two halves together against the pressure of the internal springs already mentioned. These governor springs are set so that when the inner cone is stationary it does not rub on the bore of external cone, but as soon as it picks up speed, centrifugal force automatically comes into action to throw the two halves outward and into frictional contact with the bore. This minimizes starting load imposed upon the driving motor.

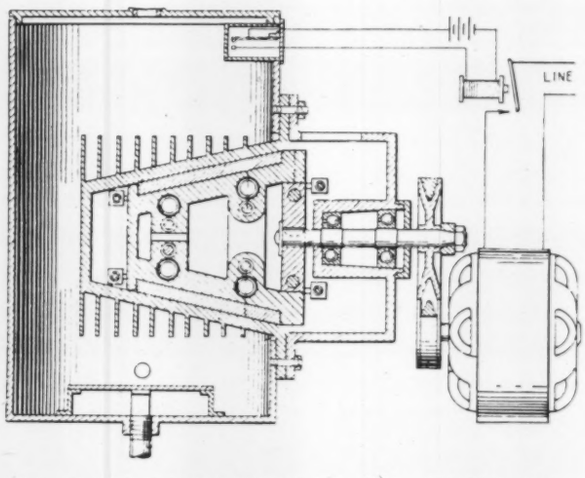


Fig. 2—Thermostatically-controlled friction device changes mechanical energy into heat

LIFE IS *getting tougher* FOR HERRINGBONE SPEED REDUCERS

—but Jones Reducers thrive on tough going!

EVERY year the conditions laid down for Herringbone reducers get tougher and tougher. Motor speeds are higher with proportionately larger ratios and smaller reducers are called for with heavier loading on the gears.

Fortunately the improvement and refinement of Jones Herringbone Speed Reducers have kept pace with the times until today there are greater values built into these reducers than would have been thought possible a few years ago.

With the accuracy and precision of Jones Herringbone Reducers goes sturdiness, compactness, symmetry and balance, and all of these mean maximum efficiency, long life and improved performance.

These reducers are built in a broad range of ratings and ratios in single, double and triple reduction types in capacities from as low as ½ H. P. to more than 400 H. P. . . . . and the Jones line covers an equally broad range of spur, gear and worm gear reducers.

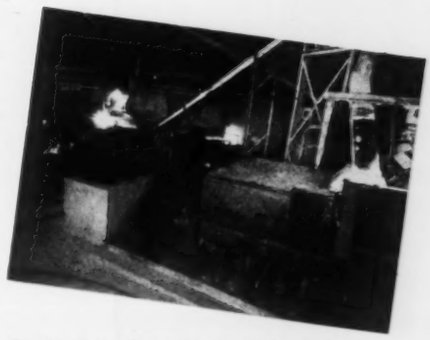
The Jones organization will be pleased to work with you and to furnish detailed information on any type of drive or drive problem.

Here's the latest information about the application of Herringbone Reducers.

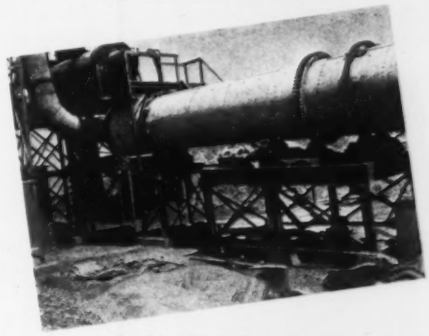
This new 96-page catalog of Jones Herringbone Reducers presents a vast amount of data relating to Herringbone Reduction Units. Illustrations show a broad range of applications and the technical information shows how to select reducers for all conditions of service in accordance with the A.G.M.A. recommended practice.

Write for your free copy of this valuable treatise.

W. A. JONES FOUNDRY & MACHINE COMPANY
4413 Roosevelt Road
Chicago, Illinois



Single Type Herringbone Reducer Driving Pug Mill and Extruder.



Double Type Herringbone Reducer Driving Stone Drier.

Double Type Herringbone Reducer Driving Forming Press.

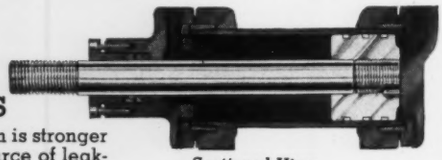
Triple Type Herringbone Reducer Driving Normalizing Furnace.

Jones Since 1890

HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS • CUT AND MOLDED TOOTH GEARS • V-BELT SHEAVES
ANTI-FRICTION PILLOW BLOCKS • PULLEYS • FRICTION CLUTCHES • TRANSMISSION APPLIANCES

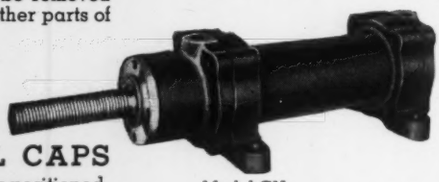
HYDRAULIC CYLINDERS
designed to match modern machine tool construction

This new type patented Hannifin high-pressure hydraulic cylinder provides every requirement for severe service and high efficiency hydraulic power. Strong, simple construction means ease of application, better appearance, and ready adaptability to a wide variety of uses.



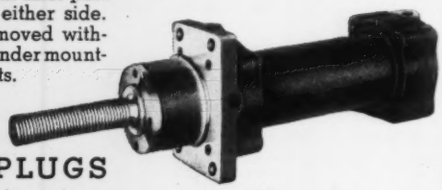
Sectional View

NO TIE RODS
This simplified design is stronger and eliminates a source of leakage. End caps may be removed without collapse of other parts of the assembly.



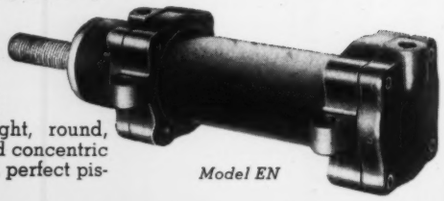
Model CN

UNIVERSAL CAPS
Either end cap may be positioned, independently, so that inlet port is at top, bottom or either side. Either cap may be moved without disturbing the cylinder mounting or any other parts.



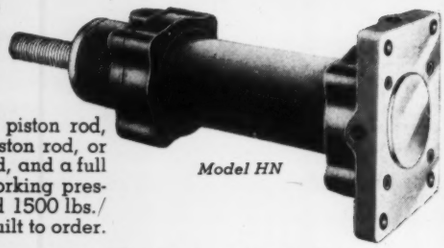
Model JN

AIR VENT PLUGS
Each end cap has air vents on three sides. With the inlet port at either side or bottom there is always an air vent plug at the top.



Model EN

LEAK-PROOF
Special mirror finish honing produces a cylinder bore straight, round, perfectly smooth, and concentric with the end caps. A perfect piston seal is obtained.



Model HN

MANY TYPES AND SIZES
Hannifin Hydraulic Cylinders are offered in six mounting types, with small diameter piston rod, 2 to 1 differential piston rod, or double end piston rod, and a full range of sizes for working pressures up to 1000 and 1500 lbs./sq. in. Other types built to order.

Write for Bulletin 35-MD giving complete data.

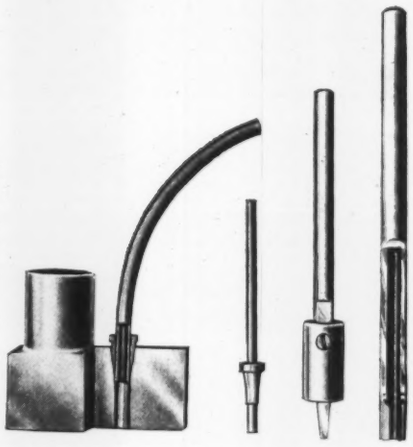
HANNIFIN MANUFACTURING COMPANY
Engineers • Designers • Manufacturers
Pneumatic and Hydraulic Production Tool Equipment
621-631 SOUTH KOLMAR AVENUE CHICAGO, ILLINOIS

HANNIFIN
HYDRAULIC CYLINDERS

NEW *Materials and Parts*

Lubrication Easy with Drive Bushing

DESIGNED to facilitate lubrication in tight places, the Bijur drive bushing connection has been devised by Bijur Lubricating Corp., Long Island City, N. Y. It provides efficient tubing connections on lubrication feed lines to bearings where space is limited and there is insufficient room for any type of threaded nut or conventional bushing. In the assembly operation, the drive bushing is placed into the mounting hole and the tube inserted as far as possible. One or two hammer blows will drive the bushing home. The taper fit causes the bushing to grip the tubing tightly and make an oiltight and dirtproof joint. Tubing as small as 3/32 inch outside diameter can be connected in this manner. For such a size, the diameter of the drive bushing collar is only 3/16 inch.



Bushing is inserted in lubrication hole and easily driven into place with hammer blow

Bimetal Temperature Gage Developed

TEMPERATURE gages of the modern dial and pointer type, having the new "coil-within-coil" design of the bimetal temperature element, have been introduced by Weston Electrical Instrument Corp., Newark, N. J. This new line of instruments has a circular dial case, three inches in diameter, and the all-metal element is sheathed within a stainless steel stem. Three models are available in ranges from 50 to 500 degrees Fahr.; 150 to 750 degrees Fahr., and 200 to 1000 degrees Fahr. Scale divisions of the circular dial are easily read; the anodized aluminum dial offers a distinct advantage since this type of scale is

Sweethearts

AND HERE'S ANOTHER

● Yes, sir, this Palmolive girl is a sweetheart, and another is the Baldwin-Duckworth roller chain that helps carry her favorite soap through its manufacture and packaging.

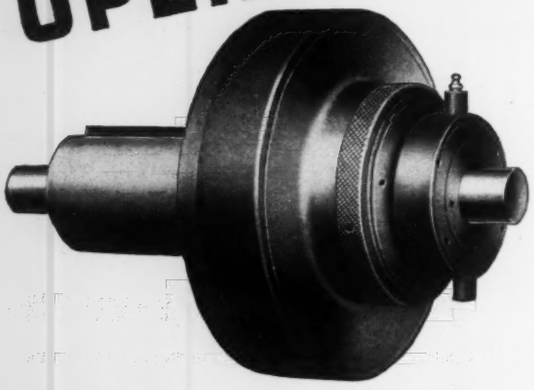
Just another example of how large "mass production" companies to whom conveying and power transmission are questions of gravest concern—turn to Baldwin-Duckworth chain.

Our engineers are qualified to give you intelligent and helpful advice on any such operation. This help is part of our regular service. Baldwin-Duckworth Chain Corporation, Springfield, Mass.

FOR FURTHER INFORMATION
SEE OUR CATALOG IN SWEET'S

BALDWIN DUCKWORTH

CAN *Absorb* THE SHOCKS OF CONTINUOUS OPERATION

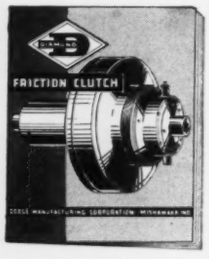


YOU CAN DEPEND ON Dodge Diamond "D" Clutches

There are probably many times when the equipment you design will be subjected to heavy shocks—when power pressures test capacities to the utmost — often a fatal spot for clutches less rugged than Dodge Diamond "D"—compact—rated to allow for 100% overload — with large friction areas — completely enclosed for workmen's safety and as full protection against dust and dirt—Dodge Diamond "D" Clutches guard your reputation for quality and dependability. Specify Dodge Diamond "D" Clutches—backed by more than half a century of leadership in the manufacture of power transmission equipment.

Write for Catalog No. A-200.

DODGE MANUFACTURING CORP.
Mishawaka, Indiana, U.S.A.



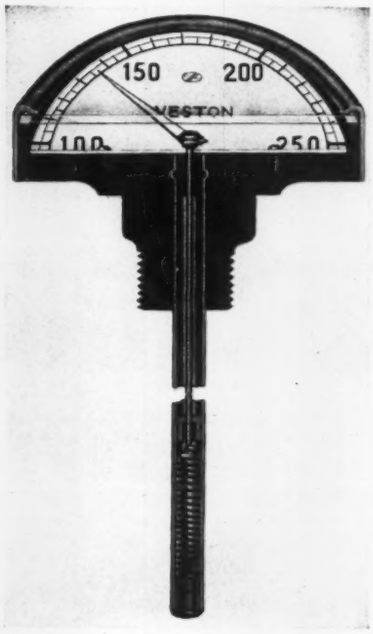
THE Right DRIVE FOR EVERY JOB

DODGE

MISHAWAKA

THERE IS ADDED VALUE IN THE NAME DODGE

unaffected by the temperature to which the head may be subjected. Accuracy is guaranteed to one per cent over the entire scale. Applications include heaters, dryers, small furnaces and similar equipment.

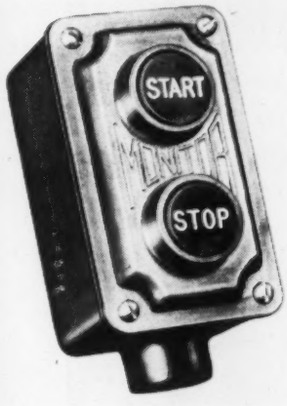


Anodized aluminum dial on gage is unaffected by high temperature

Pushbutton Control Is Developed

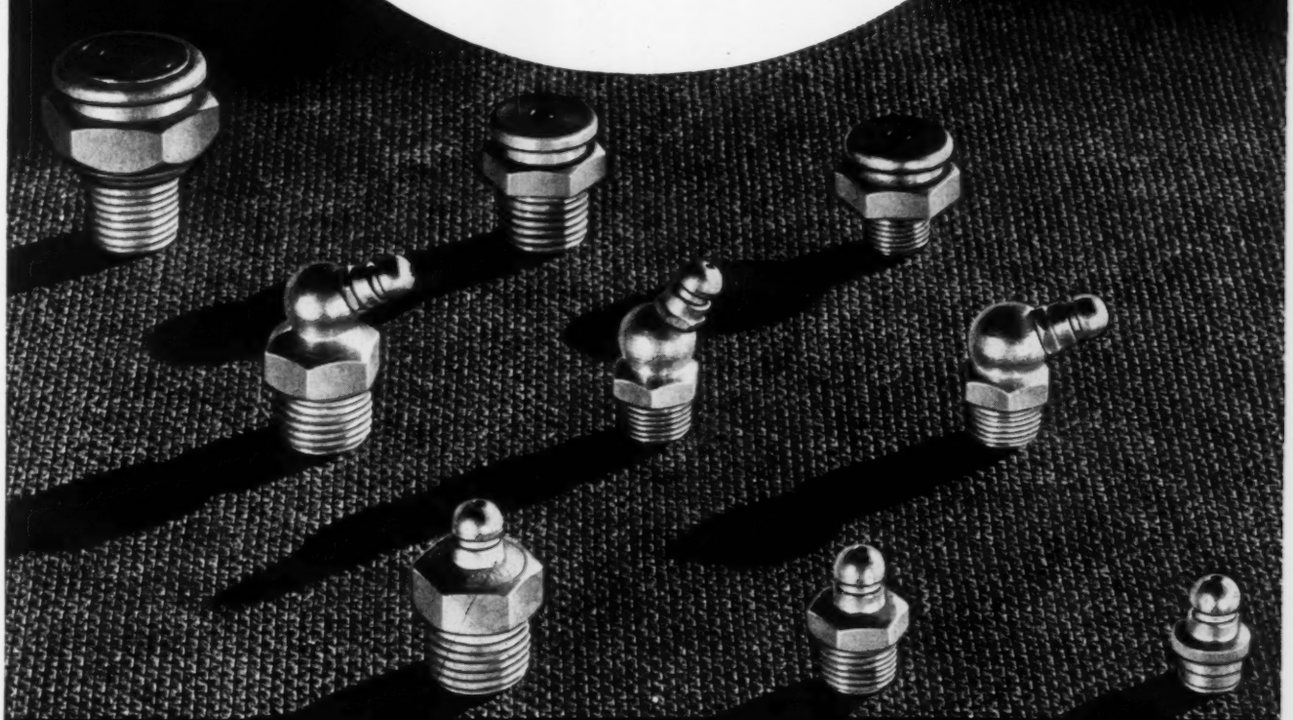
PRIMARILY intended for use in the control circuits of automatic starters, single and two-button pushbutton control stations have been brought out by Monitor Controller Co., Baltimore, Md. Contacts are silver to silver supported by copper plates mounted on an insulated base. Buttons are of colored, molded Bakelite with functions clearly engraved on each button. Boxes and covers of the controls are die cast and the former are made with an extended boss tapped for a ½-inch conduit. Overall dimensions are: height 4¾

(*Continued on Page* 64)



Colored Bakelite buttons with functions clearly engraved serve to distinguish this pushbutton station

IT PAYS
TO STANDARDIZE ON
LINCOLN
KLEENSEAL FITTINGS
if your product requires lubrication



Please write for details—and without obligating you, a Lincoln engineer will gladly confer with you relative to your particular requirements.

LINCOLN ENGINEERING COMPANY

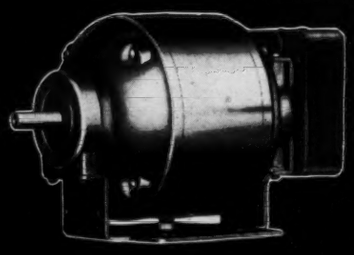
DETROIT, MICH. ST. LOUIS, MO.

BALDOR BUILDS *Better Motors*

BALDOR

Gimbal-Cushioned

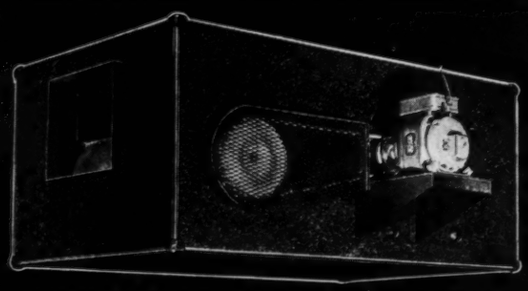
MOTORS



are

XTRA QUIET

Baldor Gimbal-mounted Motors are scientifically rubber cushioned, and are recommended for all sizes and types of Air Conditioning units and other applications where extreme quietness is necessary. Fractional h. p. up to 2 h. p. Single Phase, Split Phase, 3-Phase and Condenser types.



Complete, self-contained Air Conditioning unit manufactured by YOUNG RADIATOR CO., Racine, Wisc. Equipped with Baldor Motor.

BALDOR ELECTRIC COMPANY

4300 DUNCAN AVE. - - - - - ST. LOUIS, MO.

BALDOR

A BETTER MOTOR

(Continued from Page 60)

inches, width 2½ inches and depth 2½ inches. The two-button station is known as type 9002R and the single button as 9001R.

Rubber Hose Resists Oil and Gas

DETERIORATION of hoses handling oil or gasoline has been overcome by a new type of hose, known as "Reprene," developed by Republic Rubber Division of Lee Rubber and Tire Corp., Youngstown, O. Built with a lining of synthetic rubber, the new

Hose is lined with synthetic rubber and has steel-wire re-enforcement woven into body

hose has a steel-wire re-enforcement woven into the body and a tough abrasion-resistant rubber cover. The inside of the tube is exceptionally smooth, permitting liquid to flow without obstruction. Other features are light weight and flexibility.

Three Metals Used in Thermostat

THREE metals are used to form a new thermostatic element introduced recently by Laminated Metals Corp., 775 Eddy street, Providence, R. I. By the addition of a third metal smoother operation is obtained and a uniform thermostatic movement is accomplished throughout the operating range which is from 0 to 1200 degrees Fahr. Known as Tri-Ply this thermostatic metal has found applications in automobile carburetors, water temperature control, generator control, oil burners, alarm devices and many other appliances.

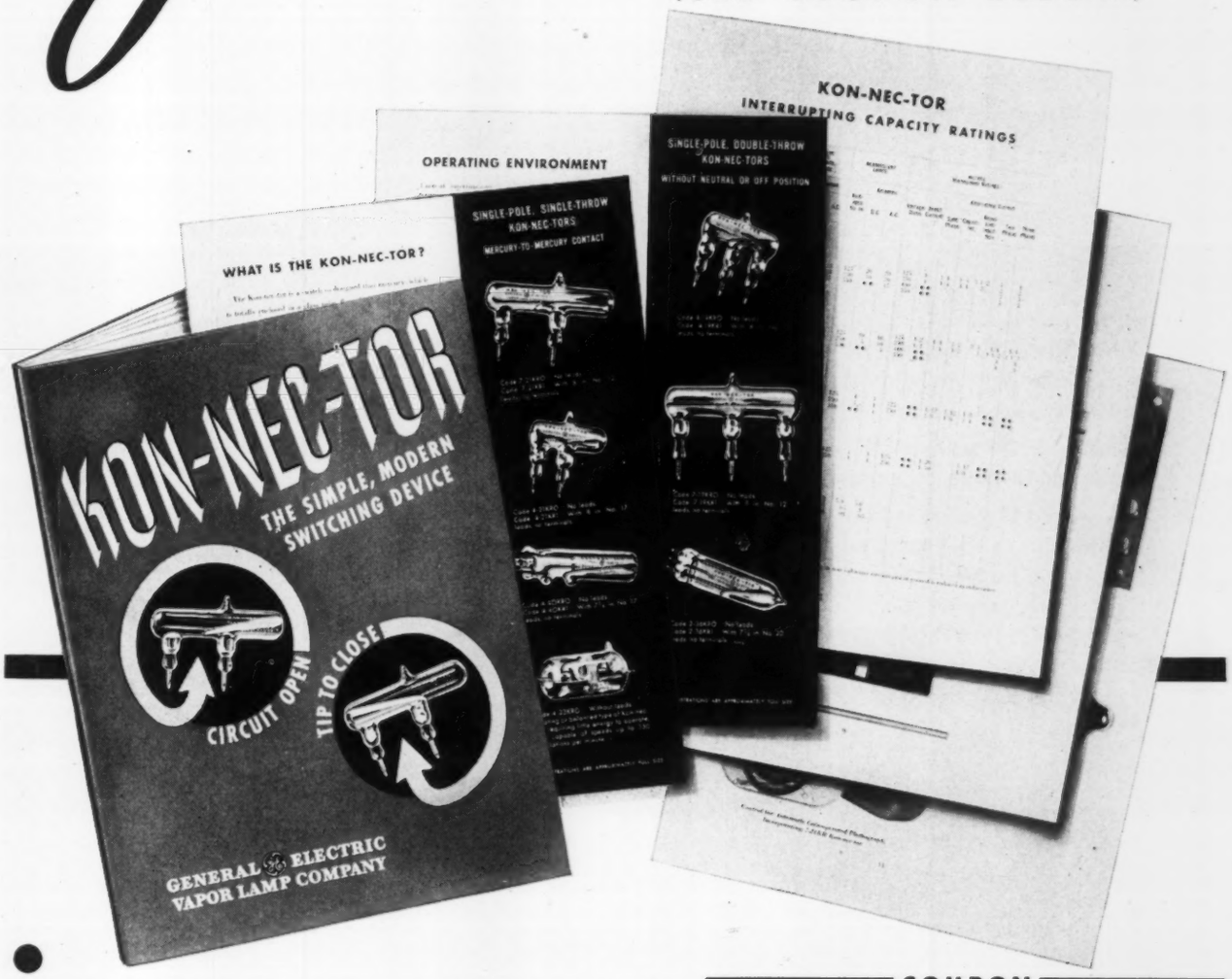
Motor-Pump Unit Announced

DESIGNED for continuous operation to circulate water in refrigerating machines, air-conditioning units, milk coolers and similar equipment, a pump sealed from the close-coupled driving motor has been introduced by L. R. H. Labaw & Co., Inc., Belle Mead, N. J. Shaft of ¼-horsepower motor is extended to eliminate a separate impeller shaft and coupling. The stuffing box is unusual in construction, possessing an

Yours FOR THE ASKING

this new book of valuable information

(SEE COUPON BELOW)



A comprehensive, factual catalog of information concerning the characteristics, capacities and uses of mercury switches! It contains a number of interesting applications in well-known equipment. The coupon is for your convenience in obtaining a copy.

GENERAL ELECTRIC VAPOR LAMP COMPANY

846K

COUPON

General Electric Vapor Lamp Company
825 Adams Street
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Gentlemen:

Please send me a copy of Bulletin No. 603.

Name..... *Title*.....

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AIR « « OR HYDRAULIC

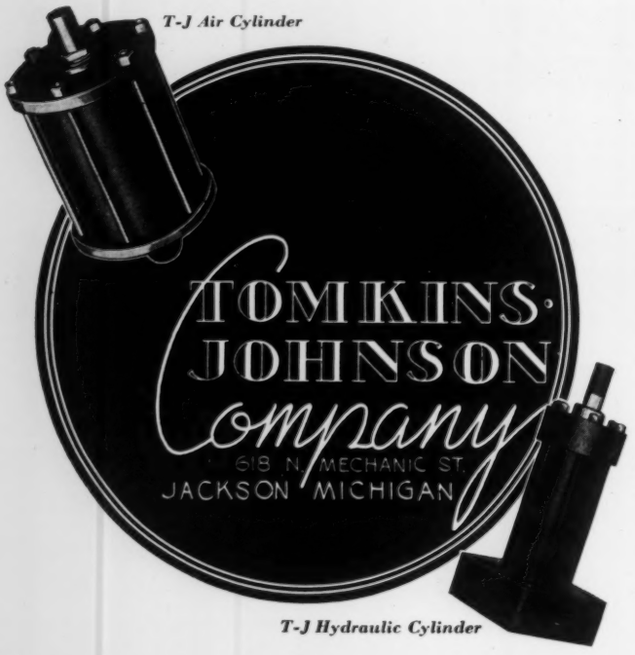
Keep abreast of the trend . . . let these two new catalogs assist you in solving your problems related to the use of Air or Hydraulic equipment. Every designer of machinery should have both publications for ready reference because they contain complete engineering data.

Request today Catalog No. H37 on hydraulic devices and No. 36 which covers air equipment.

Better T-J Hydraulic cylinders mean better performance. Or if Air Cylinders are preferred, T-J Air Equipment also meets the exacting requirements that modern industry is demanding of machinery embodying equipment of this type.

These catalogs will help you select the cylinders, valves, chucks, and special equipment which you require.

T-J Air Cylinder



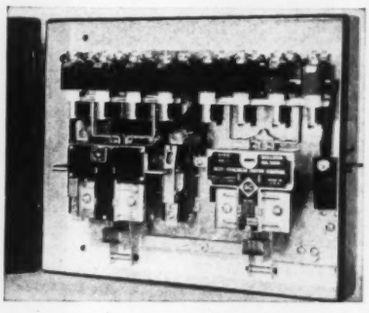
T-J Hydraulic Cylinder

oilless type bronze bushing acting as the gland, which allows no foreign matter to enter the pump bearing. Automatic operation, when so desired, is made possible by a built-in mercury switch with overload protection for starting and running coils of the motor.

Motor shaft is extended to eliminate separate impeller shaft and coupling in this unit

Two Units in Motor Starter

CONSISTING of two type AP-7 units, a new reversing motor starter, designated type AP-7-R, furnished for 7½ horsepower, 550 volts, or less, has been placed on the market by Allis-Chalmers Mfg. Co., Condit Works, Boston, Mass. The units are so interlocked that both cannot be closed at one time.

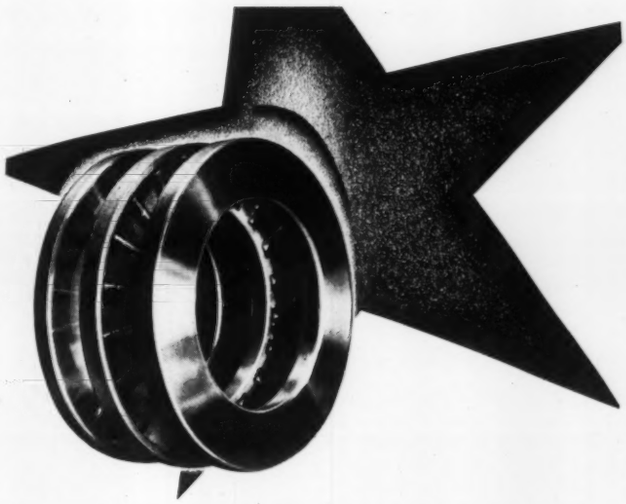


Two small units are combined to make this new reversing motor starter

"Ruptors" on the units depotentiate the arc formed by circuit interruption, lengthening the life of the contacts. Other features of the motor starter are large silver double-break contacts; vertical make and break; silent operation; pole units of individual molded bases mounted on a steel chassis, and enclosed temperature overload relays.

Oilers Have Glass Reservoir

CONSTANT level oilers known as Levomatic for automatically maintaining an accurate level of oil in ring and ball bearings of motors, lineshafts, pumps and other machinery having oil wells have been



STAR PERFORMERS ON TOUGH JOBS

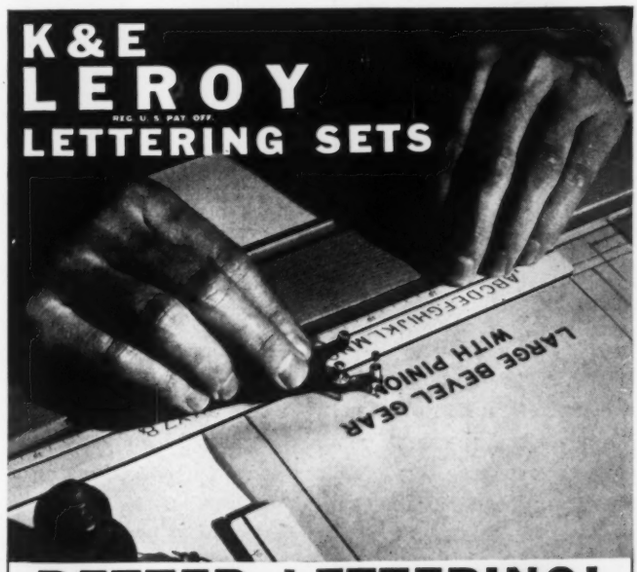
The performance of ROLLWAY straight radial and thrust Bearings on the toughest jobs is earning for them starred places in the machine picture.

ROLLWAY always chooses to make a thorough engineering analysis of every application and has the experience and production capacity to build *the right bearing for that specific job* and to deliver it *on time.*

The flexibility of ROLLWAY design service and the promptness of ROLLWAY deliveries are the outgrowth of years of specialization . . . of the creation of ample production facilities and flexibility to handle special types and sizes.

Such planned co-ordination of sales, engineering and production departments is the basis of ROLLWAY superiority . . . the reason why ROLLWAY is gaining such rapid recognition for *plus service.* Write now for a ROLLWAY analysis of your bearing problem.

ROLLWAY BEARING CO. INC., SYRACUSE, N. Y.



BETTER LETTERING!

Controlled reproduction from engraved templates gives Leroy lettering the same crisp precision as your drawings. Select a template from your Leroy set . . . follow the character outlines with the scriber . . . and the pen forms perfect lettering, directly in ink. Vertical and slanting letters can be made from the same template.

You'll want to know more about Leroy lettering. Ask your K&E dealer, or write for the new booklet.

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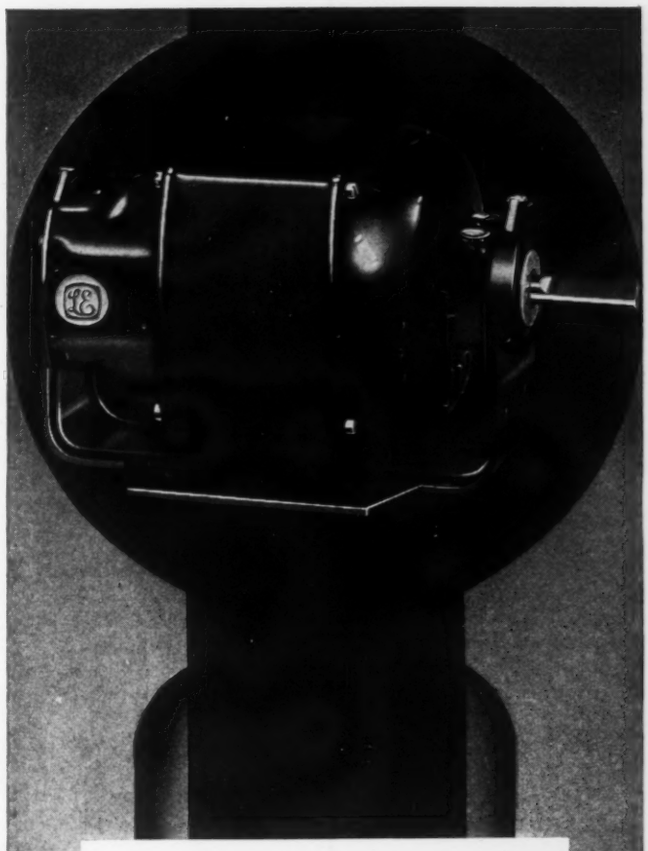
HOBOKEN, N. J.
NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO DETROIT MONTREAL



REINFORCING THE SALES APPEAL

The experienced appliance builder in the market for motors stresses these four points . . . . 1, the product technically; 2, delivery service; 3, field service; 4, dealer acceptance.

According to an impartial survey conducted by a responsible outside agency, the Leland motor stands among the leaders on all four points. This is significant, because it means that the presence of Leland motors on your appliances will materially reinforce their sales appeal.

State your particular driving requirement and obtain the Leland recommendation.

THE LELAND ELECTRIC CO.
DAYTON, OHIO

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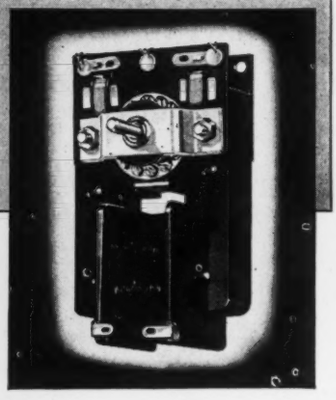
LELAND

A MINIATURE REVERSIBLE *Powerplant*



Featuring:

Compact Power
Positive Control
Universal Application

Unusually high starting torque in both directions is now obtainable in this new midget motor.

Dynamic braking and reversal of rotation are easily accomplished by simply switching in a low voltage circuit.

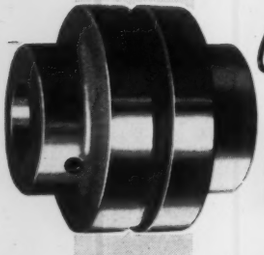
Recent developments make it possible to announce the addition of small gear reduction assemblies, integral with the motor, enormously extending the range of applications.

Both reversible and unidirectional models may now be mounted in any position, with or without speed reduction assemblies.

For additional information address your inquiries to

THE ALLIANCE MANUFACTURING CO.
South Mahoning Ave. Alliance, Ohio

CONGRESS *Flexible* MOTOR COUPLINGS



A FLEXIBLE coupling that offers machine designers a solution to obstinate coupling problems.

Couplings can be supplied with oil and water resisting inserts when required.

Congress Flexible Couplings are obtainable in six sizes for use with fractional horsepower motors or motors up to 25 horsepower and are guaranteed to be efficient, silent and low in cost.

Our engineering department will be glad to furnish complete engineering data on request.

CONGRESS TOOL & DIE COMPANY
9040 LUMPKIN STREET DETROIT, MICHIGAN

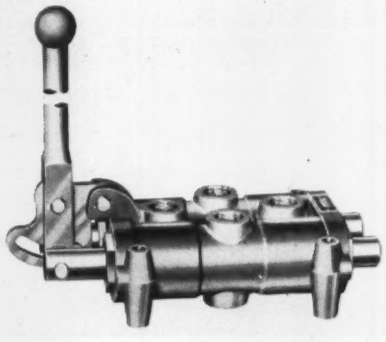
introduced by Trico Fuse Mfg. Co., Milwaukee, Wis. As oil is consumed in the bearing chamber it is automatically replaced with fresh oil from the reservoir. The device consists of a crystal clear glass reservoir

As oil is consumed in bearing it is automatically replaced by oil in small reservoir

screwed to a solid bronze, cadmium-plated fitting. The oilers are primarily designed for low cost applications on small bearings. They are made in four sizes.

Hydraulic Valve Offered

EMBODYING a no metal-to-metal construction, a hydraulic valve has been brought out by C. B. Hunt & Son's Co., Salem, O. The valves are made for two, three and four-way operation and are available in ½, ¾ and 1-inch sizes; they come in two styles, for



Construction of this hydraulic valve allows no metal-to-metal contact

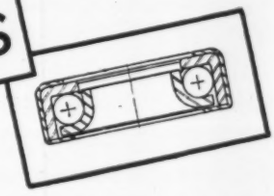
1000 and 2000 pounds working pressure. Balanced port action in conjunction with the valving ring and the no metal-to-metal contact is claimed to provide long, trouble-free service. Drop forged bronze housing resists any corrosive action.

Bearing Is of Unusual Design

UNUSUAL design is found in a new type of bearing developed by the Fast Bearing Co., Baltimore, Md. Inner member of bearing has integral shoes or blocks, being slightly tilted to permit wedge-shaped multiple oil films. The outer member has an unbroken bearing surface. Inner member turns with shaft and in so doing, centrifugal force causes oil to cover bearing surfaces with result that bearing is carried on film of oil. Load capacity is said to increase with

NICE

BALL BEARINGS

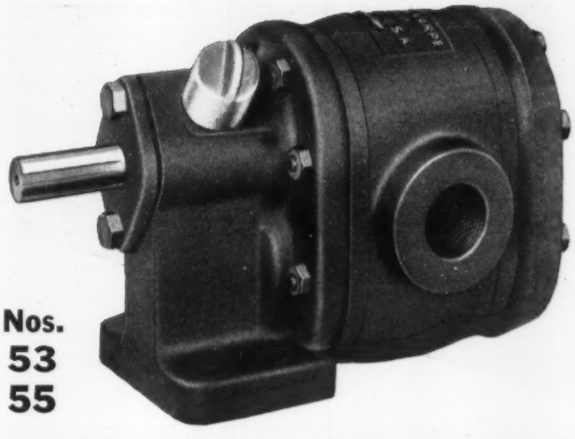


Nice Ball Bearings are used today in more than 109 different kinds of machinery — applications where bearings are specified by design engineers.

Write for your copy of our 70-page reference book (Cat. No. 102) on bearing data.

On special problems our Engineering Department is anxious to co-operate — may we have your inquiry?

NICE BALL BEARING COMPANY
2955 Hunting Park Avenue
Philadelphia NICETOWN Pennsylvania



Nos. 53 55

HELICAL GEARS and BALL BEARINGS

assure **Large Volumes—High Pressures** with quietness and dependability in supplying oil under pressure for hydraulic operation of machines. Ask for performance data, etc.

Brown & Sharpe Mfg. Co.
Providence, R. I.

BROWN & SHARPE PUMPS

B·S

SPEED REDUCERS

Backed by IXL

The Mark of Quality

THE symbol behind all IXL products stands for a high quality that was built up through three-quarters of a century spent in designing, developing and manufacturing gears. This trademark represents an organization that is thorough in its manufacturing methods—completely modern in its equipment—and unsurpassed in its engineering ability.

Precision workmanship, by long experienced men, modern plant facilities, rigid inspection, and tests of both raw materials and finished products, skilled engineers in both field and plant—all combine to insure the efficiency, quality performance and long life of each IXL unit.

Whatever your requirements in gearing may be—they deserve the attention of trained engineers who will recommend proper solutions. Call on an IXL engineer and be sure. No obligation.

A COMPLETE IXL LINE

Speed Reducers—Powered Gears—Gears of all kinds—Stoker Drives—Couplings—Special Machinery

Mail this Coupon for complete Details

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Please send me the IXL Handbook "Gear Problems"
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Title .....
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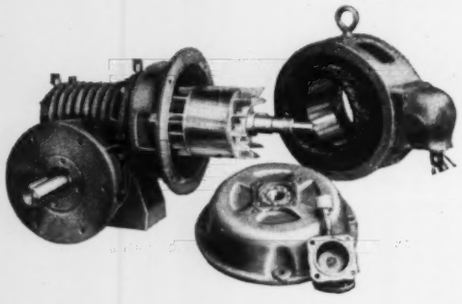
Janette
MOTORIZED SPEED REDUCERS

A PRECISION BUILT LINE OF
16 DIFFERENT TYPES
OF MOTORIZED SPEED REDUCERS,
1/50th to 7-1/2 H. P.

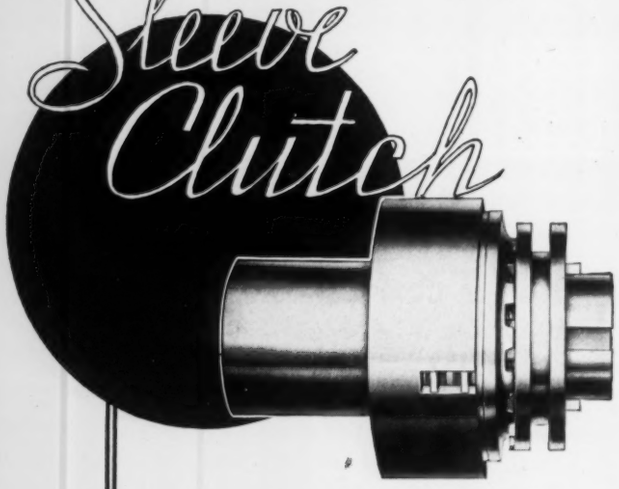


Illustrating RW-4 FLANGE MOUNTING REDUCER

The diversity of the Janette custom built line of motorized speed reducers enables us to supply a machine for almost any purpose. Let our engineers help in selecting the right type for your application.

Rotary Converters—Generators—Motors—Motor-Generators
Janette Manufacturing Company
556-558 West Monroe Street Chicago, Ill. U. S. A.
BOSTON - NEW YORK - PHILADELPHIA - CLEVELAND - MILWAUKEE - LOS ANGELES
DETROIT - SEATTLE

CONWAY
Sleeve Clutch



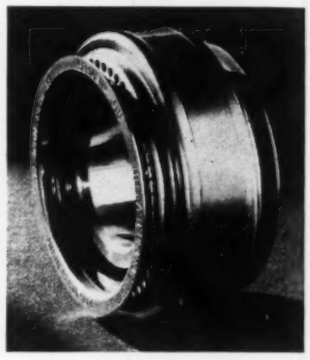
This new Conway Disc Clutch is designed for restricted swing radii and also fractional horsepowers. Has all the features of the standard models . . . full floating plates, high ratio leverage, easy engagement, instant release and free idling.

Bulletin XYZ on request.

THE CONWAY CLUTCH CO.

1546 Queen City Avenue
Cincinnati, Ohio

speed and is normally as great as that of the shaft itself. Bearings are available in either cylindrical or spherical types for thrust or location applications.

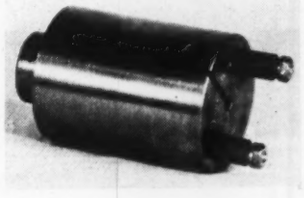


Bearings are available in either cylindrical or spherical types for ordinary or thrust applications

They are interchangeable with ball and roller bearings of standard size and may be obtained in sizes up to 5.9055 inches bore.

Solenoid Operates in Any Position

SMALL and compact, cylindrical in shape, a novel alternating current solenoid has been brought out by Kingsbury Machine Tool Corp., Keene, N. H. The coil is wound directly on a phosphor-bronze coil bushing between bobbin heads molded of a special high strength material. Rigidly mounted in a steel case the coil is protected from mechanical injury and forms a magnetic shield. Because of magnetic balance and



Cylindrical shape of solenoid permits cooling by conduction through steel housing

suitable bearing between plunger and coil bushing, operation of the solenoid is possible in any position. Cylindrical shape permits efficient cooling by conduction through housing of unit. The solenoid may be used for any ordinary application.

Molding Material Easily Formed

ESPECIALLY developed for large cabinets where appearance is an important factor, a new Durez molding material is announced by General Plastics, Inc., North Tonawanda, N. Y. It is called Durez 113 black and is being used on several of the newest radio cabinets now in production. Feature of this material is the deep black color obtained, the long draws possible and the smooth lustre. It also permits hard buffing without danger of showing filler spots.

WHY WASTE *Your* TIME

These men take the responsibility of co-ordinating electric equipment made by many manufacturers

CO-ORDINATING ELECTRIC EQUIPMENT?

WHY not save time in these busy days by delegating to one manufacturer the responsibility for all the electric equipment on your machines? The machinery builder who patches together proposals from many electrical manufacturers not only wastes time, but also takes on himself the burden of responsibility for the electric apparatus which he co-ordinates.

The executive who delegates the responsibility for electric equipment keeps himself free for broader design and production problems. He leaves to *one* electrical manufacturer the *undivided responsibility* for co-ordinating the electric equipment.

Such *undivided responsibility* is exemplified by the service General Electric offers. No need for you to patch electrical proposals together when *one* company can supply you with motors, control, transformers, instruments, and many other electric products for your machine. Just call in the engineers from our nearest sales office. General Electric, Schenectady, New York.

This executive delegates undivided responsibility for electric equipment to *one* manufacturer

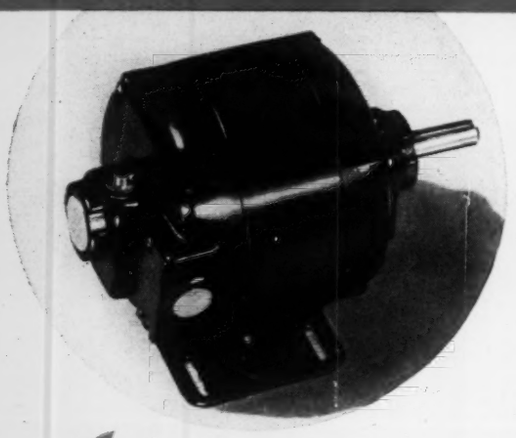
G-E UNDIVIDED RESPONSIBILITY GIVES YOU

1. More time for other jobs you have to do.
2. The *right* motors and the *right* control.
3. Service shops convenient to *all* your customers.
4. Completely co-ordinated electric equipment for your machine.

011-235

GENERAL ELECTRIC

FHP POLYPHASE MOTORS FOR EVERY JOB



A Complete Line of Ratings and Mechanical Modifications Here is a husky motor—suitable for even the heaviest duty on a wide variety of applications—for driving pumps, compressors, machine tools, industrial machinery, and garage equipment; in fact, for almost any job where polyphase power is available.

G-E polyphase fractional-horsepower motors have a flexible, widely applicable mechanical construction and are available with sleeve or ball bearings; in open, totally enclosed, or explosion-proof types; and for vertical or flange mounting. Ratings: 1/6 to 3/4 hp, inclusive; 110, 220, 440, or 550 volts; 2- or 3-phase; 60, 50, or 25 cycles. Various mechanical modifications are available for all ratings.

These motors have the same shaft and mounting dimensions as single-phase and direct-current motors of the corresponding ratings—a money-saving feature on the assembly line. Bulletin GEA-1974 gives additional information. Write the nearest G-E sales office, or General Electric, Schenectady, N. Y.

070-218

GENERAL ELECTRIC

Plastics in Machines—I

(*Concluded from Page* 39)

shaft dimension. Bearings of this construction are better suited to small machines. There are a number of outstanding laminated plastics on large machines, however particularly where water is in contact with the bearing. Steel mill roll-neck bearings, exposed to streams of cooling water, are a notable example. Previous metal bearings wore quite rapidly, but the laminated plastic, benefiting by the presence of water, stands up very well. Laminated plastic bearings have also been used in a 5000 kva. waterwheel. Instead of a continuous plastic member, the shaft is supported by longitudinal bars of laminated plastic which thrive under the conditions of water exposure.

A large number of gears and pinions are manufactured from laminated phenolic plastics. For small, fine-tooth gears a thin linen base is prefered, though canvas and heavier textile stock are common in the larger types. The outstanding characteristics of these gears are: Long life, quietness of operation and water lubrication. Innumerable examples of small plastic gears may be cited for small motors and machines, such as the gear reduction for portable drilling machines, household appliances such as the "Mixmaster," automotive timing gears, radio dial drives, kilowatt meter drive, clock movements and business machines.

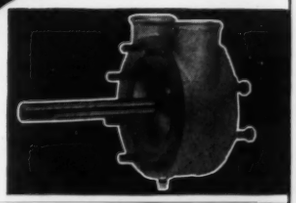
Phenolic laminated plastics have a number of applications other than gears, pinions and bearings. Electroplating barrels may be cited, where good chemical resistance, high impact strength and good wear resistance are necessary to withstand the abuse of tumbling. Barrels of this construction have been used for cadmium, copper, and nickel plating.

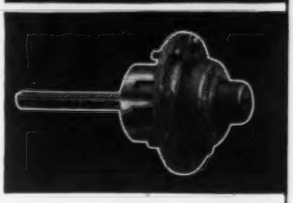
Timer Part Is of Plastic

Advantages of the high impact characteristics and resiliency of laminated plastics are well known. Typical of a mechanical part subject to continuous abuse is the revolving cam in the timing gear of the distributor, where the cam is subjected to repeated impact loading as it opens and closes a pair of contacts each revolution. Analogous to this is the contact opening mechanism illustrated in *Fig.* 3. As the eccentric rotates it bears against the laminated plastic, which has better wearing qualities than metal in an installation of this type. Casters for small maintenance trucks, pulleys for airplane control cables, chain and sprocket pulley operating in a boiling hydrochloride solution and water pump impellers are a few of the many other uses of phenolic laminated plastics.

In Part II of "Plastics in Machines" which will appear in MACHINE DESIGN next month, Mr. Delmonte discusses the outstanding characteristics of plastics, accompanied by specific references to the most appropriate material for different applications.

BUILD the PUMP INTO Your Machine





For smart appearance, compactness and economy Tuthill furnishes "stripped" pumps to enable you to incorporate the pumping elements directly into the design of your machine.

Consult our engineers. They will cooperate with you in producing pumps to meet your individual requirements.

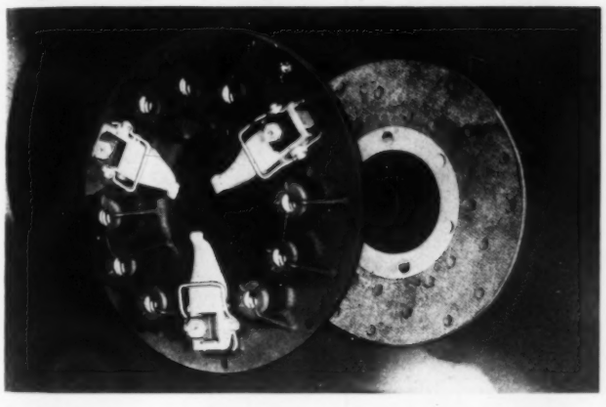
TUTHILL PUMPS FOR THE PURPOSE

Write FOR COMPLETE DETAILS

TUTHILL PUMP COMPANY
941 EAST NINETY-FIFTH ST., CHICAGO, ILLINOIS

For information on pumps illustrated, send for Tuthill "Stripped" Pump Bulletin

Spring-Loaded Clutches



Rockford Spring-Loaded Clutches operate like an automobile clutch, i.e., spring pressure holds the plates in driving contact except when separated by the operator. They are used extensively in main drives and power take-off units to transmit and control power for tractors, farm machinery, excavators, well drilling, marine and similar equipment driven by gasoline and Diesel engines. For similar applications requiring a clutch which remains positively in or out of engagement until the position of the operating lever or pedal is changed—use Rockford O-C Clutches. Reliable, efficient, durable; readily adapted to design requirements; Rockford Clutches are made with single or double drive plates, for operation in oil or dry, in sizes from 6" to 20" diameter, for transmitting 2 h.p. to 80 h.p. at 100 r.p.m. Investigate.

New Booklet—Contains complete Pullmore Multiple Disc Clutch data, shows 26 installations. Write for a free copy today.

ROCKFORD DRILLING MACHINE DIVISION
Borg-Warner Corporation, 304 Catherine Street, Rockford, Illinois

New LIGHTED PUSH BUTTON

SINGLE BUTTON BOTH CONTROLS and INDICATES

A NEW idea in push-button control, this single button both controls and indicates. Inside the large, convenient button is an indicating lamp that lights the button brilliantly as an indication to the operator.

To the machine designer, this new device means saved space, for one unit takes the place of two. It also means increased sales appeal, for the use of a lighted button in the control is not only novel, but of practical value to the customer.

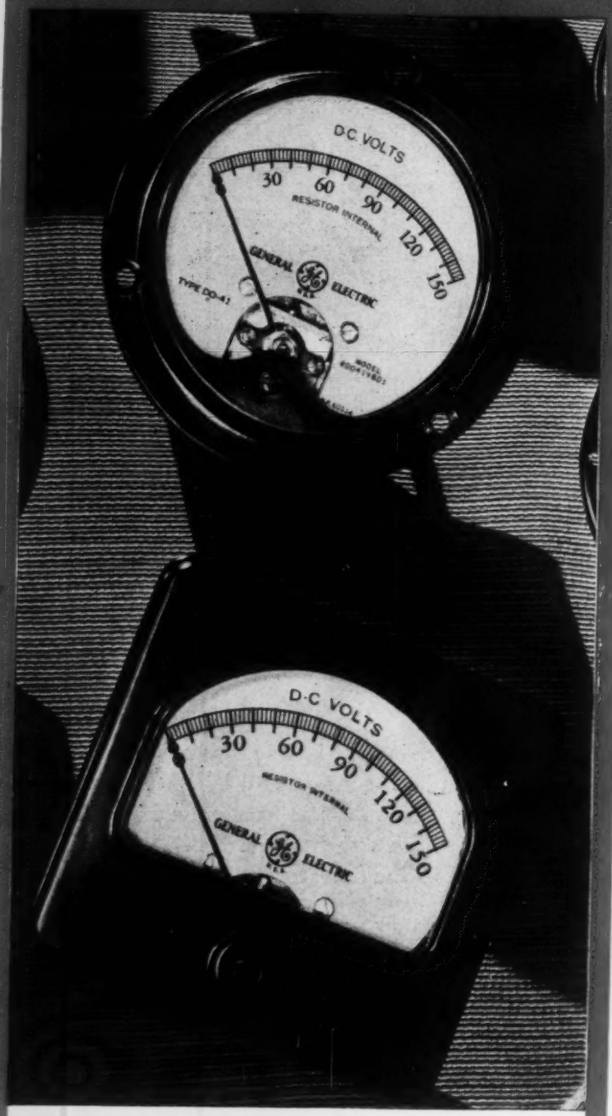
The push-button element is identical with that ordinarily used in G-E push buttons for machine tool control—a third circuit is added which connects the lamp in the indicating circuit.

We shall be glad to send you information on this new product. Address General Electric Company, Dept. 6-201, Schenectady, New York.

080-127

GENERAL ELECTRIC

IT PAYS
to Build G-E Instruments into Your Machines



IT HAS PAID other manufacturers and it will pay you to specify G-E instruments on your machines. Our engineers will be glad to modify a standard instrument to meet your requirements. Or, if you have unusual problems, they will work out a new design.

Why not take advantage of the G-E facilities and make General Electric your

Headquarters for Electrical Measurement

430-62

GENERAL ELECTRIC

MEETINGS *and* EXPOSITIONS

Oct. 12-13—

Porcelain Enamel institute. Seventh annual meeting to be held at Congress hotel, Chicago. George P. MacKnight, 612 North Michigan avenue, Chicago, is managing director.

Oct. 18-19—

Foundry Equipment Manufacturers association. Fall meeting to be held at Greenbrier hotel, White Sulphur Springs, W. Va. Arthur J. Tuscany, Penton building, Cleveland, is executive secretary.

Oct. 18-22—

American Welding society. Eighteenth annual meeting and welding exposition to be held respectively at Hotel Traymore and Convention hall, Atlantic City, N. J. M. M. Kelly, 33 West Thirty-ninth street, New York, is secretary.

Oct. 18-22—

American Institute of Mining and Metallurgical Engineers. Meetings of the Institute of Metals and Iron and Steel divisions to be held at Atlantic City, N. J. Louis Jordan, 29 West Thirty-ninth street, New York, is assistant secretary.

Oct. 18-22—

National Metal exposition. Nineteenth annual national metal show to be held in Atlantic City auditorium, Atlantic City, N. J. Additional information may be obtained from W. H. Eisenman, managing director, American Society for Metals, 7016 Euclid avenue, Cleveland.

Oct. 24-29—

National Electrical Manufacturers association. Annual meeting to be held at Palmer House, Chicago. W. J. Donald, 155 East Forty-fourth street, New York, is managing director.

Oct. 27-Nov. 3—

National Automobile Show. To be held at Grand Central Palace, New York. Myron C. Foy, President of DeSoto division of Chrysler Corp., is chairman of the show committee.

SPRING WASHERS

Spring washers and lock washers of every type and size, including the well-known Hipower and Kantlink types. There are thousands of more places where spring washers would improve the value of any product where bolts, nuts, cap or machine screws are used.

STEEL BARREL CLOSURES

Forged and machined fittings for steel barrels, drums, tanks and metal packages, including plugs, rings and flanges. Very rugged for use in transportation of alcohol, turpentine, oils and other expensive liquids.

STEEL ROD ENDS

Drop forgings including steel rod ends of the adjustable yoke, plain yoke, and eye types. These articles in standard sizes and threads afford tremendous savings over special designs.

CONTAINER HANDLES

Forged steel handles for heavy containers—can be rigidly welded, riveted or attached by a strap to lie flat when not in use. Rugged and most satisfactory for hard usage.

RETAINING RINGS

Spring retaining rings of special heat-treated spring steel are carried in many stock sizes—both open and closed types. Use of a spring retaining ring is an excellent manner of creating a shoulder on a shaft.

RHEOSTATS—RESISTORS—LOAD BOXES AND SPECIAL APPARATUS

Our electrical division—Hardwick, Hindle, Inc.—makes as fine electrical resistance products, fixed and variable, as can be devised.

Other products include windows for buses and railway cars, railway car window curtains, curtain rollers and fixtures, sash locks and lifts.

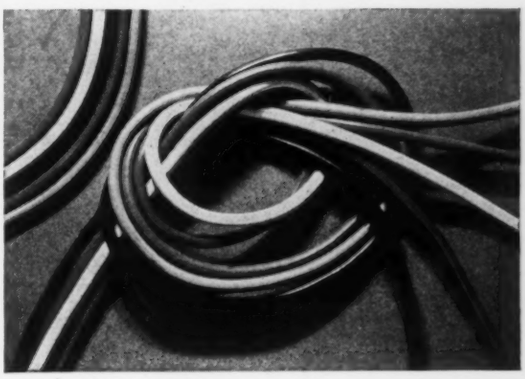
THE NATIONAL LOCK WASHER COMPANY
NEWARK, N. J.—EXPORT DIV., 15 E. 26 ST., N. Y. C

FLAMENOL

REG. U. S. PATENT OFFICE

WIRE FOR YOUR MACHINES

Adds New Talking Points



WHEN you can say that your product is wired with Flamenol, you give prospects some refreshing news.

Flamenol—the G-E synthetic rubber-like compound that covers this wire—is a natural for sales talks. It combines the properties of an insulation and finish, and seldom needs any protective covering. It is flame-, moisture-, and oil-resisting, superaging, and good-looking. It comes in many bright colors, making easy the identification of circuits.

Look into Flamenol wire for low-voltage circuits on high-grade equipment—such as machine tools; for battery, coil, and motor leads and for any use where its properties are the only ones that fully meet conditions. More information will gladly be given; address the nearest G-E sales office or General Electric, Dept. 6A-201, Schenectady, N. Y.

520-124

GENERAL ELECTRIC

CHECK YOUR PROCESS FOR ELECTRIC HEAT

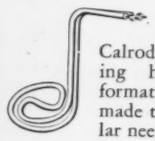
"SPOT"

Branding irons
Cellophane sealing machines
Cigarette machines
Clothes-pressing devices
Electric evaporators
Embossing machines
Harness-making machinery
Laundry machinery
Laboratory hydraulic presses
Line-casting machinery
Locomotive rail sanders
Optical tools
Package-wrapping machinery
Paper-box machines
Sanforizing machinery
Shoemaking machinery
Textile machinery
Wire and cable machinery

"Spot," the G-E cartridge heater, concentrates heat where needed, in just the quantity required. Self-contained, "Spots" eliminate steam and gas piping, and fumes in the workplace. Available in a multitude of sizes and ratings.

SPECIAL CALRODS

Air filters
Air-conditioning machinery
Branding irons
Can-soldering machines
Car-heating units
Chemical tanks and stills
Doughnut-making machines
Frankfurter cookers
Hydraulic presses
Labeling machinery
Laundry machinery
Line-casting machines
Matrix presses
Ovens
Paper-container machines
Paraffin heating
Paraffin-spraying machines
Plating tanks
Shoemaking machinery
Snow melters
Type-melting pots
Unit air heaters



Calrod unit, showing how special formations can be made to fit particular needs.

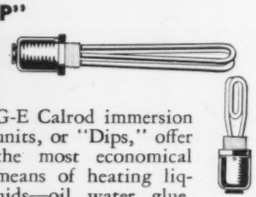
"STRIP"

Beer-vat dryers
Box-toe steamers
Dairy sterilizers
Fruit colorizers
Fruit conditioning
Incubators
Matrix scorchers
Plate whirlers
Preheating oil
Small ovens

G-E "Strips" are made with steel sheaths for operation at temperatures up to 750 F, and with chrome-steel sheaths for temperatures up to 1200 F. Unusual strength, coupled with ease of installation, recommends "Strip" for process machinery.

"DIP"

Airplane tenders
Brooders
Candy-coating machines
Coal-treating machines
Dairy sterilizing machinery
Egg sterilizers
Fruit sterilizers
Incubators
Industrial cleaning tanks
Oil-heating equipment
Oil purifiers
Paper-box machinery
Shoemaking machinery
Steam generators
Steam radiators
Stills and sterilizers
Vulcanizers



G-E Calrod immersion units, or "Dips," offer the most economical means of heating liquids—oil, water, glue, paraffin, and others.

Complete information on G-E heating units for process machinery is contained in our "mail-order catalog," GED-650. Write for a copy. General Electric, Schenectady, N. Y.

160-52

GENERAL ELECTRIC

MANUFACTURERS' PUBLICATIONS

ALLOYS (COPPER) — Comprehensive booklet on Herculoy, a copper-silicon alloy, has been issued by Revere Copper and Brass Inc., 230 Park avenue, New York. Applications, specifications and general data on the alloy are included.

ALLOYS (MOLYBDENUM)—Bound in looseleaf form an attractive booklet has been prepared by Climax Molybdenum Co., 500 Fifth avenue, New York, giving comprehensive data concerning the use of molybdenum in cast iron.

ALLOYS (NICKEL) — Composition, properties, heat treatment and applications are included in bulletin T-9 on the engineering properties of "K" Monel metal issued by The International Nickel Co., Inc., 67 Wall street, N. Y.

ALLOYS (STEEL)—Instructions on methods of fabricating stainless steel with information as to the grades of tool steel best suited for specific operations is contained in "The Working of Silcrome Stainless Steel", released by Ludlum Steel Co., Watervliet, N. Y.

ALLOYS (STEEL)—Printed in two colors, a 68-page booklet has been issued by United States Steel Corp. Subsidiaries, 434 Fifth avenue, Pittsburgh, describing Cor-Ten, a high-strength, corrosion-resistant steel of many uses.

CLUTCHES—Construction details, applications and specifications of friction clutches are given in booklet No. 1532, issued by Link-Belt Co., Chicago.

CONTROLS (ELECTRICAL)—Complete line of GE Kon-nec-tor mercury switches is described in a 12-page bulletin issued by General Electric Vapor Lamp Co., Hoboken, N. J. It is designated as catalog 603 and features illustrations of the 12 common types of mercury switches.

CONTROLLERS—Full line of Klixon thermostatic controls is described in a 48-page catalog of the Spencer Thermostat Co., Attleboro, Mass. Catalog includes electric and gas-actuated controls for heating appliances, room thermostats, limit controls, thermal relays, etc.

COUPLINGS—Collection of data sheets in bound form giving construction and specifications of the different couplings made by Ajax Flexible Coupling Co., Westfield, N. Y., has been issued by the company.

FASTENINGS—The second in a series of folders dealing with the use of Dardelet self-locking threads on cap and set screws has been issued by Dardelet Threadlock Corp., 55 Liberty street, New York. It is bulletin No. 17.

FASTENINGS—Chart giving the recommended standard sizes together with manufacturing tolerances for KantLink spring washers has been prepared by The

for crank pin bearings,
eccentric straps, etc.

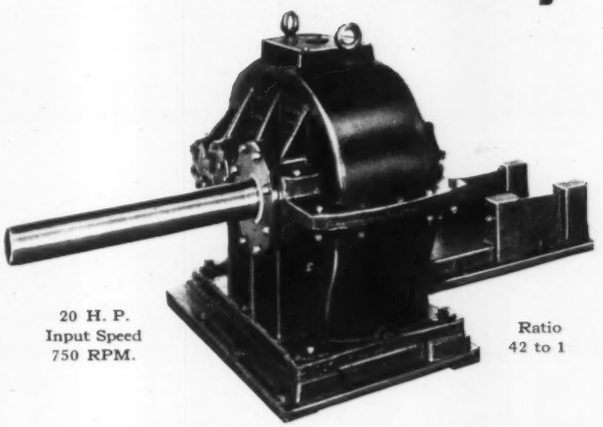
LAMINUM SHIMS provide accurate adjustments . . . Right at the machine! Simply p-e-e-l one or more .003" laminations at a time from the solid brass shim. Production delays avoided . . . No filing, no grinding . . . • The same economy, the same precision in factory assembly and in every service adjustment for the life of the bearings.

LAMINATED SHIM CO., INC., 21-26 44th Ave., Long Island City, N.Y.
Cleveland Detroit Milwaukee

814

LAMINUM
Precision adjustment **SHIMS**

Brad Foote's Reducer In The Coal Industry



20 H. P.
Input Speed
750 RPM.

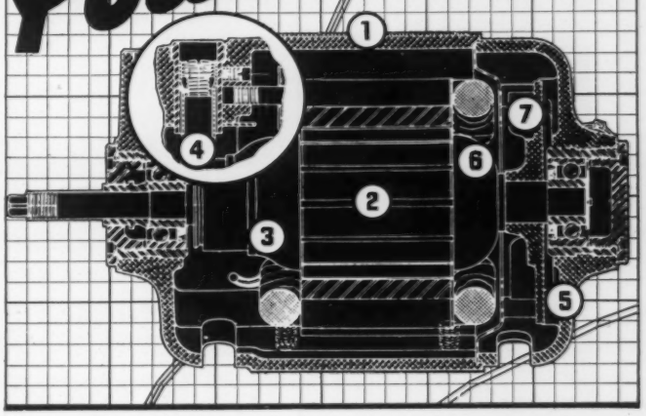
Ratio
42 to 1

This 15-D-22-Brad Foote double Herringbone Reducer—with shaft extended for outboard bearing—designed for service in the coal industry—serves daily without interruption—its continuous, dependable operation is evidence of correctness in design—high quality of workmanship and materials that go into all Brad Foote products.

Send for new modern Speed Reducer Manual

FOOTE GEAR WORKS INC.
1301-G. S. Cicero Av. Cicero, Illinois

SEE FOR YOURSELF WHY DUMORE MOTORS GIVE MORE *Power Hours*



The statement that Dumore motors deliver *more* Power Hours is not just an idle claim. Take *any* Dumore motor apart . . . or better still, see them made. Here's what you'll find:

(1) Every unit inspected *5 times* (2) Every armature dynamically *balanced* (3) Commutator leads *swaged* by special Dumore process (4) All commutators *ground* concentric with bearings (5) Every motor actually *run-in* to seat its brushes (6) Armature windings *sealed* against centrifugal "breathing" (7) Forced ventilation *built-in.**

Ask a Dumore user his opinion. He'll convince you further. Dumore series universal motors (AC-DC) are giving *extra* power hours on hundreds of machines. Available in 1/600 h.p. to ¾ h.p. . . . 0 to 60 cycles, they are the ideal drive for many types of equipment ranging from heavy shop tools or fine jeweler's lathes.

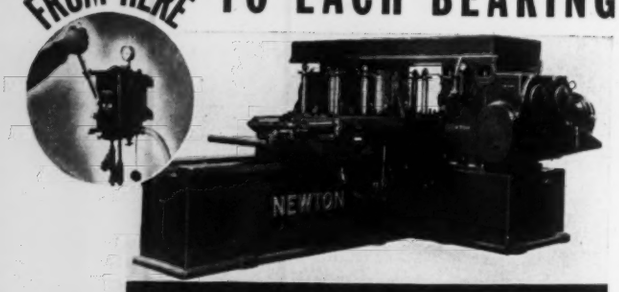
Let Dumore engineers solve *your* problem. Write for a Dumore engineering service application blank and catalog.

THE DUMORE CO., DEPT., 127-K RACINE, WIS.

**Except in totally enclosed motors*

DUMORE
FRACTIONAL HORSEPOWER
MOTORS

FROM HERE TO EACH BEARING



With Accurate Control Throughout

OILERS *may* know the location of every bearing on the equipment you design and build, but there is danger that they will overlook the remote ones when hurrying to get the job done!

Your customer *ought to* know—because guesswork in hand lubrication cannot be tolerated. A single burned-out bearing may paralyze production of a machine, a department, or even an entire plant.

But—with Farval on your equipment, it is not necessary that *any* of you shall know—because a Farval Centralized System supplies positive lubrication to *all* bearings, with accurate control throughout.

Farval delivers clean lubricant from a central station under high pressure, to a group of bearings in exact, measured quantities. It quickly pays for itself through reduced labor of oiling, reduced power consumption and increased bearing life.

A nearby Lubrication Engineer will gladly call for a consultation on the correct system of lubrication for machines you design. The Farval Corporation, 3265 E. 80th St., Cleveland, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Cleveland, Manufacturers of Automotive and Industrial Worm Gearing.

FARVAL

CENTRALIZED SYSTEM OF LUBRICATION

Special Delivery to Every Bearing

National Lock Washer Co., Newark, N. J. The chart is 12½ x 18 inches.

FINISHES—Two bulletins Nos. 4527 and 4917 describe a tarnishproof lacquer for brass and silver and an outdoor lacquer for these metals. The bulletins are issued by Roxalin Flexible Lacquer Co., Inc., Elizabeth, N. J.

FITTINGS—First complete data bulletin on Haveg pipe, fittings, valves and fume duct has been issued by Haveg Corp., Newark, Del. In addition to mechanical details it includes table of chemical resistance properties.

HEATING ELEMENTS—Catalog E of Acme Electrical Heating Co., Boston, Mass., gives complete information on electric heating elements produced by the company, and their application in parts and equipment.

INSTRUMENTS — Information on the complete line of indicating, recording and controlling instruments for temperature and pressure is given in a 56-page catalog, No. 1060C, released by C. J. Tagliabue Mfg. Co., Park and Nostrand avenues, Brooklyn, N. Y.

INSTRUMENTS — Plant temperature instruments are described, illustrated, and applications shown in a pamphlet issued by Leeds & Northrop Co., 4904 Stenton avenue, Philadelphia, Pa.

MOTORS—Bulletin 227, issued by Janette Manufacturing Co., 556 West Monroe street, Chicago, describes motorized speed reducers, blowers, motor-generator units, etc. made by the company.

PACKING AND PACKING GLANDS—Description of flexible metallic and Dura Plastic packings are given in a leaflet prepared by Durametallic Corp., Kalamazoo, Mich.

SPEED REDUCERS—Motorized speed reducers and plain reducers are described in catalog 101 just issued by Boston Gear Works, Inc., North Quincy, Mass. Fourteen types of both motorized and plain reducers are listed in the catalog.

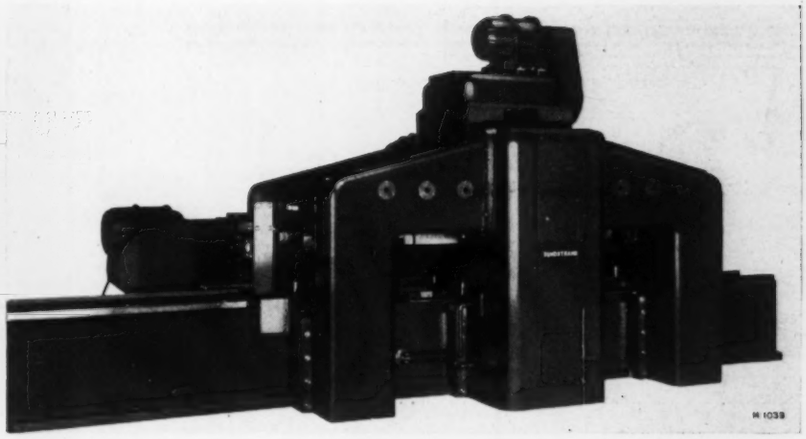
VARIABLE SPEED DRIVES—General data on the JFS-Jr. Vari-Speed control is contained in a bulletin issued by Columbia Vari-Speed Co., Wheaton, Ill.

WELDED PARTS AND EQUIPMENT—P. R. Mallory & Co., Inc., Indianapolis, Ind., has published a book on the theory and practice of resistance welding, entitled *"Engineering Data."* The four sections of the book deal with resistance welding methods, materials to be welded, Mallory alloys, and miscellaneous tables. It sells for $2.

WELDED PARTS AND EQUIPMENT—Bulletin No. 20, covering "Amsco" hard-facing welding rods, has been released by American Manganese Steel Co., 389 East 14th street, Chicago Heights, Ill.

WELDED PARTS AND EQUIPMENT — Complete handbook information on design and layout of piping for welded connections is contained in "Design of Welded Piping", a 200-page book containing over 100 figures and illustrations, published by The Linde Air Products Co., New York.

SUNDSTRAND HYDRAULIC EQUIPMENT



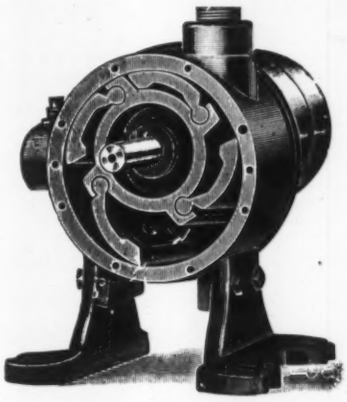
Operates Work-Handling Devices and Milling Heads in 32-Ton Automatic Machine

● In the automatic milling machine illustrated, automobile cylinder blocks are received at left from the shop conveyor, advanced in tandem pairs, shifted sideways, elevated, and clamped in position. A 4-spindle head automatically rapid approaches, face mills two end-surfaces on each block, quick returns, and stops. Work pieces then return to bed of machine, advance to a second station for straddle milling of crankshaft bearings, then move to a third station for finish milling of end surfaces after which they are delivered at the right-hand end of the machine adjacent to the shop conveyor.

One Sundstrand WX Pumping Unit actuates all of the automatic work handling devices on this machine including the reciprocating shuttle by means of which the work pieces are progressed from one end of the machine to the other. Sundstrand 10 PWX Pumping Units provide adjustable automatic operating cycles for the three milling heads. Sundstrand Cycle Valves, Solenoid Valves and other controls assure reliable operation and correct timing. Demonstrated clearly in this machine; the easy application, simplicity, dependability, power, and other outstanding advantages of Sundstrand Hydraulic Equipment are equally effective in many other kinds of machinery, large or small. Investigate. Write today for complete information.

SUNDSTRAND MACHINE TOOL CO., *Pump Division*
2550 Eleventh Street **Rockford, Illinois, U. S. A.**

Standard Equipment on all sorts of Air Using Devices and used by the world's leaders . . . . .



LEIMAN BROS.
Patented
Rotary Positive
AIR PUMPS
for pressure, vacuum and gas pumping.

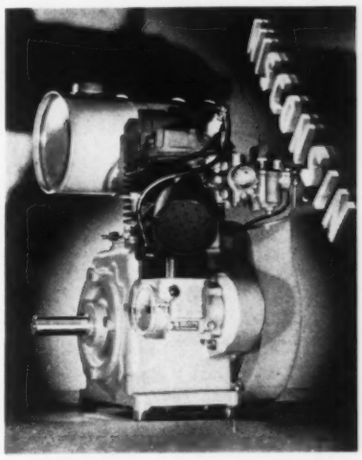
AIR MOTORS
They take up their own wear

NEW POSSIBILITIES OF DESIGN IN AUTOMATIC MACHINES and DEVICES readily suggest themselves as you study the various present uses of these pumps.

GET THE FREE INFORMATION

LEIMAN BROS., INC.

177 Christie St., Newark, N. J.
LEIMAN BROS. NEW YORK CO., 23P Walker St., New York
Makers of Good Machinery for 50 Years



A reproduction of AB—2 H. P. Single Cyl. Engine.

•

9 sizes—1 to 16 H.P.
1200 to 2400 R.P.M

WISCONSIN BUILDS ONLY HEAVY-DUTY ENGINES

Our engineers therefore think only along the lines of "hard usage." That is why Wisconsin engines are known the world over for their long life and dependability.

HEAVY DUTY AIR COOLED ENGINES BY WISCONSIN MOTOR CORPORATION

WISCONSIN
MOTOR CORP., MILWAUKEE, WIS.

Designers!

The Directory bound into the center of this issue (pages 1D-48D) will assist you in selecting the proper engineering material to meet a specific application. Consult the listings, and the advertising pages, before you specify. Better designs can be developed by employing this useful guide. ● The Fifth Edition of this Directory of Materials, which supplements the current issue, is significant of MACHINE DESIGN'S constant efforts to serve its readers. ● Every copy of the regular issue includes the Directory. Additional, separate copies of the Directory are available at 25 cents each.

MACHINE DESIGN

Penton Bldg., Cleveland, O.

POSITIONS

AVAILABLE OR WANTED

DESIGN Analyst: I specialize in improvements designed to eliminate manufacturing or service troubles in machinery. Sound analyses based on up-to-date knowledge of mechanics including vibration, also applied thermodynamics. Intimate knowledge of all basic metal-forming processes. Open for engagement soon. Address Box 110, MACHINE DESIGN, Penton Building, Cleveland, O.

CLASSIFIED advertisements are set in eight point Stymie bold face type, approximately eight words to a line. Rates are as follows:

Positions Available—20c a word, with a minimum charge of $10.00, which permits the use of fifty words.

Positions Wanted—10c a word, with a minimum charge of $3.00, which permits the use of thirty words.

The box number will be counted as one line or eight words.

MACHINE DESIGN

Penton Building Cleveland, Ohio

Business and Sales Briefs . . . . . .

FOR the past two years in the sales department of the Laminated Shim Co. Inc., Long Island City, Richard Seipt has been made sales manager of the company. Previously Mr. Seipt was connected with John Wood Mfg. Co. as a sales engineer.

* * *

Smith Power Transmission Co. is now located in its new offices, 410 Lakeside avenue, Northwest, Cleveland.

* * *

W. C. Schade has been named to represent the Duraloy Co., Scottdale, Pa., in the Midwestern territory.

* * *

Eugene D. Wilson, 703 Columbian Mutual tower, Memphis, Tenn., has been named district representative in that territory for Foote Bros. Gear & Machine Corp., Chicago.

* * *

For the past nine years New York district manager of the Aluminum Company of America, S. J. Simmons was recently named assistant general sales manager, with headquarters at Pittsburgh.

* * *

Linde Air Products Co., New York, has opened a new sales office at 3710 San Pablo avenue, Oakland, Calif., to serve the Oakland area, supplementing the San Francisco office.

* * *

David C. Babcock has been appointed representative in the Michigan territory for the Kropp Forge Co., Chicago. He will make his headquarters at 863 Southfield road, Birmingham, Mich.

* * *

Opening of a branch office in Baltimore has recently been announced by L. W. Harston, vice president in charge of sales of Steel & Tubes Inc., subsidiary of Republic Steel Corp., Cleveland. H. H. Smith is in charge of the new office.

* * *

Appointment of Edward P. Geary as midwestern sales manager of Rustless Iron & Steel Corp., Baltimore, has recently been announced. With headquarters at 4013 Milwaukee avenue, Chicago, Mr. Geary will be in charge of sales in Illinois, Wisconsin, Indiana, Iowa and Missouri. He was formerly Chicago district sales manager for the Colonial Steel Co.

* * *

Removal of its Kansas City branch sales offices and stockrooms to 1922 Grand avenue, has recently been announced by Bunting Brass & Bronze Co. Irving Eldred is branch manager of the newly equipped and much larger quarters. Another announcement made by the company is that of the appointment of Gordon Schutzen-

RACINE

Variable Volume Hydraulic Pump

A thoroughly proven, efficient pump for power transmission.

Capacities—
0 to 2000
0 to 4000
0 to 6000
cu. in. per min.

The variable volume feature eliminates by-passing of surplus oil, decreases heating and reduces horse-power requirements. Rated for pressures up to 1000 pounds per square inch.

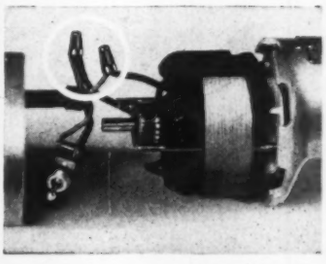
Successfully applied and proven highly satisfactory on such applications as:

Presses
Die Casting Machines
Welding Machines
Chucking Operations
Machine Tools
Table Movements
Stokers
Conveyors
Broaching Machines
Bending and Rolling Equipment, etc.

A variety of valves and controls are available for standard operations

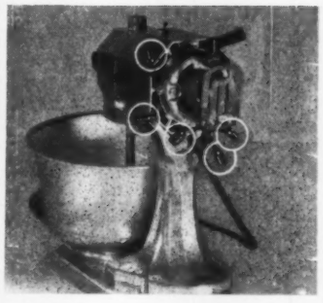
RACINE TOOL & MACHINE CO.
1773 State St. Racine, Wis.

IDEAL CONNECTORS = LOWER COSTS
SOLDERLESS-TAPELESS = BETTER WORK



Speed work, reduce operations and cost in the production line. Make a better joint electrically; a stronger joint mechanically.

Proven stronger and better electrically than solder-and-tape joints. Twist on with the fingers like a nut on a bolt. No tools required.



Resists heat, cold, or moisture better than other type wire joints.

Fully approved—Listed by Underwriters' Laboratories.

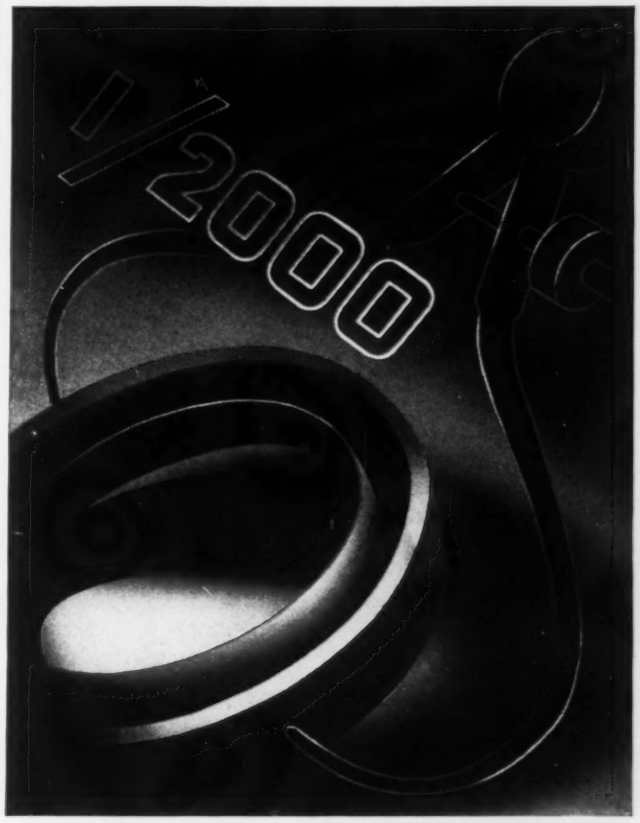
Millions in Use!

Send for free samples.

LEADING MANUFACTURERS HAVE STANDARDIZED

IDEAL COMMUTATOR DRESSER COMPANY
1059 Park Avenue Sycamore, Illinois

A hydraulic jack may be idle for months at a time . . . but the packing must stay perfect. It can't dry out . . . stiffen . . . crack . . . or shrink . . . no matter how little use it gets. One manufacturer inquires about G & K Packings—



Can you hold them to two-thousandths of an inch?

We can. And we do. For that manufacturer—G & K Packings are keeping their shape and size—delivering full power all the time—protecting the Packing Point* on his machine.

Not all packing jobs require such precise manufacturing standards as this one . . . but G & K engineers can cope with practically any packing problem you give them—using Home of Research Leathers which are specially tanned to resist water, oil, heat, semi-corrosive liquids, etc.

Why not write us for a free pamphlet on Hydraulic and Pneumatic Packings?

**The vital point in any machine using Packings ... the point about which Graton & Knight "X-Ray Thinking" should be consulted — if possible, during the design stage.*

Graton and Knight
HOME of RESEARCH
WORCESTER, MASS.

"X-Ray Thinking" at the Packing Point

dorf as sales representative in the Eastern territory, with headquarters at the company's New York city branch offices.

* * *

W. A. Neill has been appointed manager of engineering and sales activities at the recently opened plant at Holyoke, Mass., of Worthington Pump & Machinery Corp., Harrison, N. J.

* * *

Howard V. Harding has become associated with Lukenweld Inc., division of Lukens Steel Co., Coatesville, Pa., as district sales manager in the metropolitan area, with headquarters at 120 Liberty street, New York.

* * *

New district offices, in charge of Joseph Gardberg, have been opened in New Orleans, by Cutler-Hammer Inc., Milwaukee. W. E. Ragsdale has been named manager of the Dallas, Tex., office of Cutler-Hammer Inc., Milwaukee.

* * *

Allen-Bradley Co., Milwaukee, has recently announced the appointment of Wilson Electrical Equipment Co., 2009 Capitol avenue, Houston, Tex., as new representative in the southern territory, with W. F. Wilson, president of the latter company, in charge.

* * *

Frank Campbell Coe, sales engineers located in the Commercial Trust building, Fifteenth and Market streets, Philadelphia, have been named representatives of Graham Transmissions Inc., manufacturers of the Graham variable speed transmissions. Eastern Pennsylvania, Southern New Jersey, Maryland, Delaware and the District of Columbia is the territory to be covered from the new office.

* * *

According to a recent announcement, Wellman Bronze & Aluminum Co., Cleveland, has instituted its own complete pattern-making department in order to facilitate production and to meet increased business demands. The company is also building an addition to its plant at 6017 Superior avenue, Cleveland.

* * *

Lincoln Electric Co., Cleveland, has added W. W. McClellan to its sales engineering staff at its Grand Rapids, Mich. office. Mr. McClellan has had considerable practical experience, having been engaged in maintenance welding for Campbell, Wyant & Cannon Foundry Co., and as general welder for E. W. Bliss Co., and General Motors Corp.

* * *

With offices at 1208 North Broad street, Philadelphia, W. P. White has been appointed district manager in charge of steel and tube sales in the eastern and southern Pennsylvania district by the Steel and Tube Division of the Timken Roller Bearing Co. Mr. White will be assisted by C. H. Kuthe. A. R. Adelberg, district manager in charge of the Timken Steel and Tube division sales in New York city, with offices at 165 Broadway, will supervise the Philadelphia district as well as the New York city area.

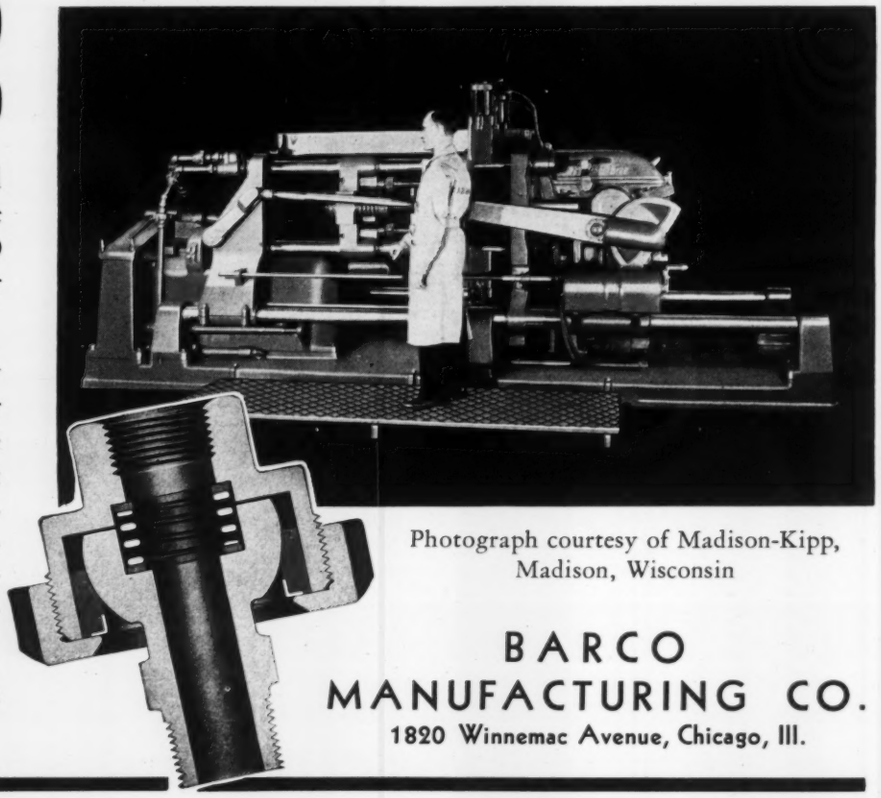
30,000 POUND DIE CASTING MACHINE

BARCO EQUIPPED

To assure smooth, full-powered performance by this immense die-casting machine, BARCO Ball Joints equip its power lines.

Their leak-proof dependability insures every pound of air reaching the heads. The flexibility permits highest speed operation. Long-life service means lowest cost maintenance. Look to BARCO for the solution of your Flexible Joint Problems.

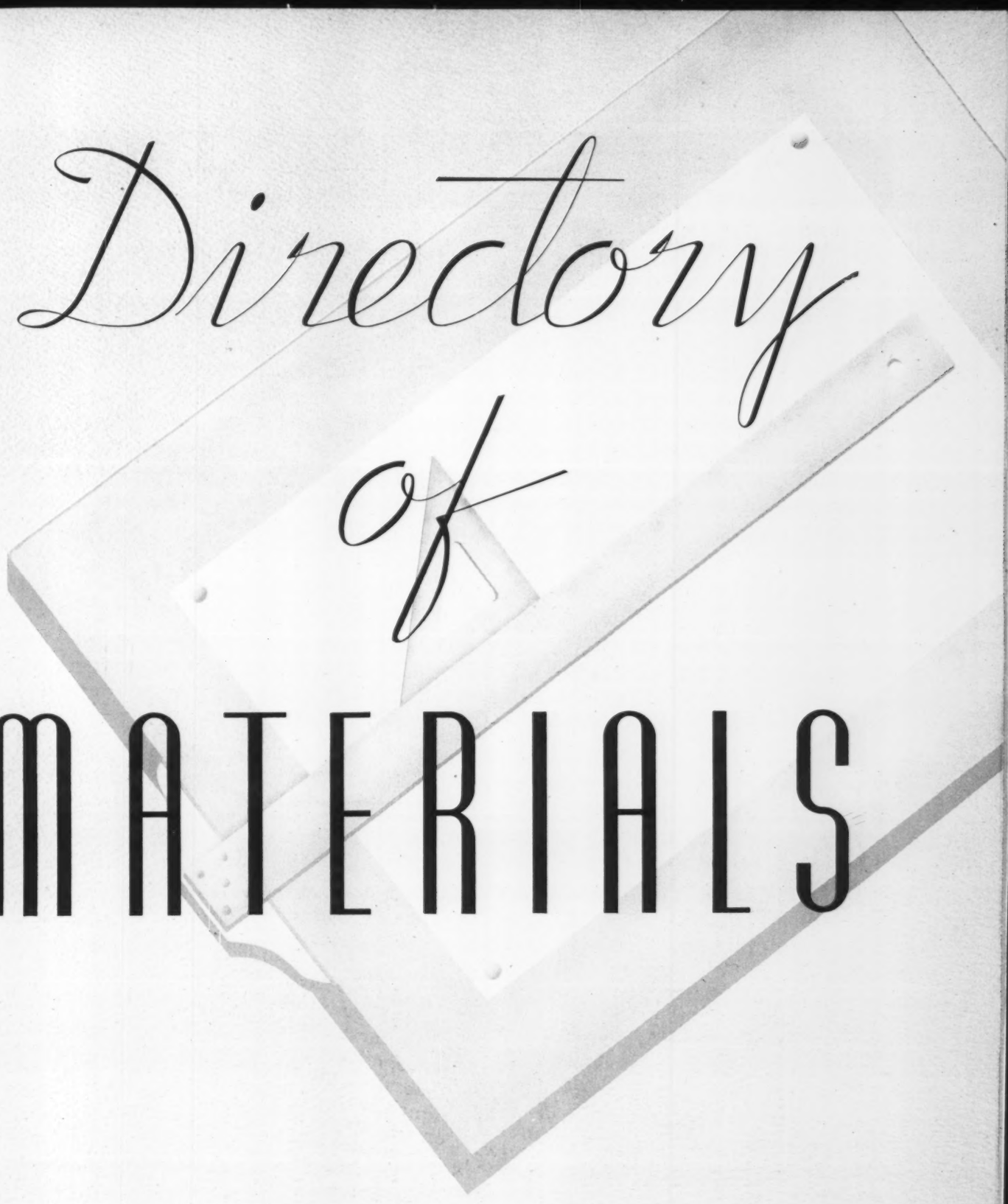
Send today for Catalogs 206 and 256.



Photograph courtesy of Madison-Kipp, Madison, Wisconsin

BARCO MANUFACTURING CO.
1820 Winnemac Avenue, Chicago, Ill.

Directory of MATERIALS

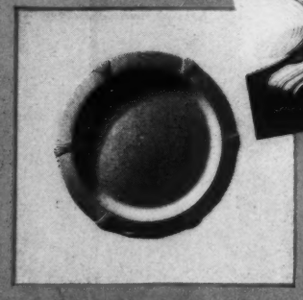


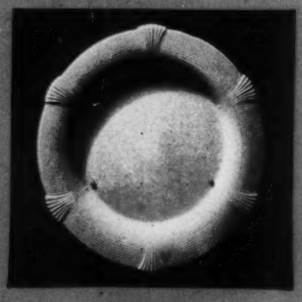
Fifth edition of MACHINE DESIGN'S Directory of Iron, Steel and Nonferrous Alloys, Plastics and other Nonmetallic Materials—as utilized in the design of machinery of all types and sizes

SUPPLEMENT TO OCTOBER, 1937, ISSUE

OFF THE FIRE

Onto the table





WITH G-E PLASTICS

"Servet" Stainless Steel Dishes, created by Steelsmiths, Inc., Meriden, Conn., possess all the attributes of modern cooking, plus the remarkable new feature of serving at the table in the same dishes the food is cooked in. Hence, off the fire — onto the table. General Electric molds the beautifully designed trays on which the dishes rest while on the table. Heat-proof, accurate molding, appearance and molded color are the reasons for Steelsmiths specifying G-E moldings. The "Servet" trays are another good example of what can be done with plastics when the customer's requirements are carefully studied and molding knowledge intelligently applied.

Rely on General Electric for your molded parts. For information, write Plastics Department, General Electric Company, Pittsfield, Massachusetts.

GENERAL ELECTRIC

Plastics

PLASTICS DEPARTMENT, GENERAL ELECTRIC COMPANY
PITTSFIELD MASSACHUSETTS

ACCURATE...or else!

● Always vital is the *precision fabrication* of airplane parts. Yet the Booth precision-cut felts for gyroscope and other aircraft assemblies are held no more rigidly to specifications . . . are die-cut with no finer accuracy . . . than the Booth felt parts utilized in a hundred-and-one industries. ● The secret? Booth-designed precision equipment . . . Booth's long specialization in "prescribing" and supplying the *correct* felt for each industrial job! Write for felt sample chart.

BOOTH FELT COMPANY, INC. • ESTABLISHED 1905 • 444 NINETEENTH STREET, BROOKLYN, N. Y.

TRADE Booth MARK

PRECISION CUT FELT

COMPLETELY revised and brought up to date, this fifth edition of MACHINE DESIGN'S directory of materials used in the design of machinery is presented as a supplement to the regular October issue. As customary with these reference supplements the directory is stitched as a separate unit and is then stitched into the issue proper, thus being readily removable without damage to either.

CONSIDERABLE new information is included in this edition of the directory. Besides numerous extra listings of metallic and nonmetallic materials, and the enlargement of previously-published data, the directory now contains a cross-reference listing under the names of producing companies.

NUMERALS are used in both the metallic and nonmetallic sections of the directory, above each listing, to classify the properties of the materials and to assist in their selection. Where numerals are shown only on the line immediately above the tradename, all types or grades produced under that tradename possess the properties designated by the numerals. When properties vary with the grades, classifying numerals appear above each individual grade to designate the three major properties of each, and additional properties are given in the text.

NEW ALLOYS, specially-processed irons and steels, plastics and other non-metallic engineering materials will be announced as they are developed, in the "New Materials and Parts" section of MACHINE DESIGN'S regular issues.

Iron, Steel and Nonferrous Alloys Listed by Tradenames

(For listing by producing companies, and complete street addresses, see page 40 D.)

A

1 - 3 4 - - - - -

ABRASOWELD — Lincoln Electric Co., Cleveland. Arc welding electrode for providing abrasion resisting, self-hardening deposit which hardens rapidly under impact and abrasion; maximum hardness develops at surface, leaving cushion of softer metal beneath; provides resistance to abrasion in straight carbon, low alloy or high manganese steel surfaces; effective on gear and pinion teeth

1 2 3 4 - - - - -

ACME—Acme Steel Co., Chicago. Stainless strip steel.

1 2 3 - - - - - -

Type 410; chromium 10 to 13.5, carbon .12 max., silicon .5, manganese .5, phosphorus and sulphur .025.

Type 430; chromium 14 to 18, balance of analysis same as Type 410.

1 - 3 4 - - - - -

Type 320; chromium 17 to 19, nickel 7 to 9, carbon .08 to .20, balance same as Type 410.

Type 304; chromium 17 to 19, nickel 7 to 9.5, carbon .11 max., balance of analysis same as Type 410.

- - - 4 5 6 - - -

ACORN—A. W. Cadman Mfg. Co., Pittsburgh; babbitt metal furnished in ingots; brinell hardness 70 degrees Fahr. 22.3, 212 degrees Fahr. 8.2; compressive strength 12,000 pounds square inch; for bearings having reciprocating motion, subject to excessive pound or vibration.

- - 3 - - - - - -

ADAMANTINE — Babcock & Wilcox Co., New York. Special steel castings with wear-resisting qualities and machinable surfaces; for grinding mills, mixers, conveyors, power shovels.

- - 3 4 - - - - -

ADAMITE — Mackintosh-Hemphill Co., Pittsburgh. Alloy steel characterized by strength plus wear resistance.

1 - 3 - 5 - - - -

ADMIRALTY BRONZE—Chase Brass & Copper Co. Inc., Waterbury, Conn., and Scovill Mfg. Co., Waterbury, Conn. Copper 70, tin 1, zinc 29; standard alloy for condenser tubes, particularly for salt or brackish water.

1 2 - 4 - - - - -

ADNIC—Scovill Mfg. Co., Waterbury, Conn. Copper 70, tin 1, nickel 29; tubing, rod, wire and sheet.

- 2 - - - - 7 - -

ADVANCE—Driver-Harris Co., Harrison, N. J. Copper 55, nickel 45; resists heat up to 1500 degrees Fahr; thermocouple material for application where low temperature coefficient of resistivity is required; also for measuring instruments, industrial and radio rheostats and elevator controls.

- - - 4 - 6 - - -

AERISWELD—Lincoln Electric Co., Cleveland; arc-welding electrode; for welding of bronze, brass and copper either in manufacturing or maintenance work.

- - - 4 5 - - - -

AGATHON — Alloy Steel Div., Republic Steel Corp., Massillon, O. These alloy steels meet demands for material of lighter weight, greater strength, resistance to shock, impact and torsional strain, and high fatigue resistance; for severe service.

1 - - - - - - 7 - 9

ALCOA—Aluminum Co. of America, Pittsburgh. Aluminum alloys for sand, die and permanent mold castings; also available in form of plate, sheet, foil, bars, rods, wire, tubing, moldings, structural shapes, forgings, screw machine products, rivets, and stampings; grades with varying compositions to meet specific requirements.

1 - - - - - - 7 - -

ALCUMITE—Duriron Co. Inc., Dayton, O. Copper 90, aluminum 9, iron 1; for pumps, valves, pipe, fittings, bars and castings for corrosive service where a copper base alloy is preferred.

1 2 - 4 - - - - -

ALCUNIC—Scovill Mfg. Co., Waterbury, Conn. A nonferrous alloy in tubing, rod, wire and strip form.

- - - - - - 6 - - -

ALLAN RED METAL—A. Allan & Son, Harrison, N. J. Copper lead-bearing alloys; segment castings for facing pistons; bearings for turbines, centrifugal pumps, high speed grinders, etc.

1 2 - 4 5 - - - -

ALLEGHENY—Allegheny Steel Co., Brackenridge, Pa.

1 - - - - - - - - -

Metal, grade C; carbon .08 to .20, phosphorus max. .025, sulphur max. .025, silicon max. .50, manganese max. .50, chromium 17 to 19, nickel 7 to 9; for dairy and food processing equipment, automobile and building trim, chemical plant, household and kitchen accessories.

1 2 - - - - - - - -

33, Stainless type 410 ("to be heat treated to specific physical properties"); also available in stainless types 403 (turbine quality), 405 (non-hardening quality), 416 (free machining), and Allegheny 33-W (type No. 418). Carbon max. .12, manganese max. .50, phosphorus max. .025, sulphur max. .025, silicon max. .50, chromium 10 to 13.5; resists temperatures up to 1500 degreeh Fahr.; for automotive parts, combustion and steam engine parts, chemical plant equipment, tanks, fans, blowers and furnace parts.

- 2 - - 5 - - - -

44, Stainless type 309; carbon .20 max., manganese 1.25 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 22 to 26, nickel 11.0 to 13; resists scaling at temperatures up to 2000 degrees Fahr.; malleable and ductile; used for furnace parts, industrial ovens, kiln linings, still tube supports and pump parts.

46, Stainless types 501 and 502; carbon .10 maximum: manganese .50 max., phosphorus .04 max., sulphur .04 max., silicon .50 max., chromium 4 to 6; following elements may be added for increased resistance to oxidation and for improved mechanical properties: Molybdenum .40 to .60, tungsten .75 to 1.25, copper 0.5 to 1; for nonhardening characteristics aluminum .10 to .25, titanium or columbium ten times carbon per cent; adaptable for wide range of uses in the oil industry.

- 2 - - - - - - - -

55, Stainless type 446; carbon .25 max., manganese 1.00 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 23 to 30; for high temperature service up to 2150 degrees Fahr., used for furnace parts, boiler baffles, kiln lining, pyrometer protection tube, glass molds, oil still tube supports, etc.

1 2 - 4 - - - - -

66, Type 438; also available in modified form in types 66-W (No. 438) containing tungsten, and 67 (No. 442) containing .35 carbon. Carbon max. .12, manganese max. .50, phosphorus max. .025, sulphur max. .025, silicon max. .50, chromium 14 to 18; resists oxidation to temperatures up to 1600 degrees Fahr.; used for steel engine parts, low temperature furnace parts, fans and blowers, evaporators and chemical plant equipment.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

1 - - 4 - - - -

ALLEGHENY METAL—Allegheny Steel Co., Brackenridge, Pa.

Grade A, No. 304; stainless type; carbon .11 max., manganese .50 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 17 to 19, and nickel 7 to 9.

Grade B, No. 305; stainless type; carbon over .08 to .20, manganese .50 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 18 to 20, and nickel 8 to 10.

Grade B Special, No. 306; stainless type; carbon .11 max., manganese .50 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 18 to 20, and nickel 8 to 10.

Grade C, No. 302; stainless type; carbon over .08 to .20, manganese .50 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 17 to 19, and nickel 7 to 9.

No. 303 (free machining quality); stainless type; carbon over .08 to .20, manganese .20 to 1.20, phosphorus .17 max., sulphur .60 max., silicon .70 max., chromium 17 to 19 and nickel 7 to 9.

No. 307 (Allegheny 22); stainless type; carbon over .08 to .20, manganese .50 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 19 to 22, and nickel 9 to 12.

No. 308 (Allegheny 22 Special); stainless type; carbon .11 max., manganese .50 max., phosphorus .025 max., sulphur .025 max., silicon .50 max., chromium 19 to 22 and nickel 9 to 12.

Where fabrication requires deep drawing welding or severe cold work, Grade B (No. 305) will be found superior in most cases to Grade A (No. 304) because it has less tendency to work harden and requires much more cold work to make it magnetic. Its combined chromium and nickel insures greater stability than that of Grade A after short time heating such as in the welding operation. The higher carbon content also produces an alloy with higher true proportional limit and tensile strength giving greater resistance to reverse bending stresses thereby reducing the tendency for fatigue failure.

When special conditions of service justify the use of Allegheny Metal with additions of columbium, molybdenum, titanium, vanadium, or other elements, such modifications of Allegheny Metal will be furnished upon request.

Foregoing metals used for food and dairy equipment, chemical equipment, household equipment, and for railroad and automotive industries.

- 2 - - - - 7 8 -

ALLOY 10—Hevi Duty Electric Co., Milwaukee. Chromium 37.5, aluminum 7.5, iron 55; for resistor elements in heat treating furnaces at temperatures of 2300 to 2400 degrees Fahr.

- - - - - - - 7 - -

ALNICO—General Electric Co., Schenectady, N. Y., and Simonds Saw & Steel Co., Lockport, N. Y. Permanent magnet alloy of high coercive force; nickel 20 to 30 per cent, aluminum 10 to 12, cobalt 3 to 5, balance iron; extremely hard and obtainable in cast form. Continental Motors Corp. is licensee for automotive and radio industry.

1 2 - 4 - - - - -

AMBRAC—American Brass Co., Waterbury, Conn. Grade A; copper 75, zinc 5, nickel 20; used for condenser tubes, etc.

- 2 - - - - - - -

AMBRALOY—American Brass Co., Waterbury, Conn. Aluminum bronze alloys for varied special uses.

1 2 3 - - - - - -

AMERICAN—American Stainless Steel Co., Pittsburgh.

Stainless steel; chromium 8 to 60, carbon over 0.12, balance mostly iron; for oil, textile, pumping machinery, and other equipment requiring a corrosion resistant, tough, hard, high strength, heat treated alloy.

Stainless iron; chromium 8 to 60; carbon 0.12 or under, balance mostly iron; for oil, dairy, laundry, textile, paper, refrigerating equipment, etc.

1 2 3 4 5 - - 8 -

AMSCO—American Manganese Steel Co. Inc., Chicago Heights, Ill.

- - 3 4 5 - - - -

Manganese steel; 10 to 14 manganese, 1 to 1.40 carbon, balance iron; suitable for sand casting; for power shovel dippers and teeth, rock crusher parts, dredge pumps, etc.

1 2 - 4 - - - - -

Alloy F-1; 15 to 17 chromium, 34 to 36 nickel; for conveyor chain, enameling furnace supports, burner parts etc.; heat resistant up to 2000 degrees Fahr.; creep resistant at high temperatures.

F-3; 27 to 29 chromium, 0 to 3 per cent nickel; for rabble arms and blades, sintering bars, etc.; heat resistant up to 1800 degrees Fahr. where temperature changes are not wide and where high unit strength is not essential.

F-5; 17 to 19 chromium, 65 to 68 nickel; furnace conveyor pans, heat treating boxes, enameling fixtures, etc.; similar properties to F-1 and F-6, except tougher and more resistant to temperature fluctuations.

F-6; 12 to 14 chromium, 59 to 62 nickel for heat treating boxes, retorts, etc.

F-8; 20 to 22 chromium, 8 to 10 nickel; for mine water and acid pump parts, marine fittings, chemical mixer and paper mill digester parts.

1 2 - - - - - - - -

F-10; 26 to 28 chromium, 10 to 13 nickel; for heat treating furnace shafts, dampers and valves, cement kiln cooler parts, etc.; creep resistant at high temperatures.

- - 3 - 5 - - - -

Nickel-manganese steel; 13 to 15 manganese, .75 to .95 carbon, .95 to 1.20 silicon, 3.50 to 4.50 nickel; welding rod for building up austenitic manganese steel castings.

No. 459; chromium molybdenum hard alloy welding rod for hard surfacing machinery wearing parts; deposits are 500 to 600 brinell.

No. 217; welding rod for hard facing cast wearing parts; extreme hardness and great wear resistance.

1 2 - 4 - 6 7 - -

ANACONDA—American Brass Co., Waterbury, Conn.

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Beryllium Copper; copper 97.75, beryllium 2.25, nickel 0.25; for springs, diaphragms, low duty bushings and bearings.

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"85" Red Brass; copper 85, zinc 15; pipe tube and sheet forms; particularly resistant to salt water corrosion.

1 2 - - - - - - - -

Super-Nickel; copper 70, nickel 30; seamless tubes, sheets and plates; for severe condenser tube service and resistance to salt water corrosion.

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Special Phosphor Bronze; copper 88, tin 4, zinc 4, lead 4; combines general characteristics of standard phosphor bronze alloys with free cutting qualities of yellow brass.

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ANFRILOY—Wellman Bronze & Aluminum Co., Cleveland. A copper-lead-tin bearing bronze for high speed, light duty bearings and for bushings where pressure and thrust are not excessive.

1 - - 4 5 6 - - -

AMPCO METAL—Ampco Metal Inc., Milwaukee. Resistant to caustic solutions, brines and sulphuric acids and pickling solutions.

Grade 16; copper 86.20, aluminum 10.20; iron 3.30, special agents .30; brinell 150; for bearings, steady rest rollers, press gibs, trolley shoes.

Grade 18; copper 84.80, aluminum 11.40, iron 4.70; special agents .40, brinell 175; for acid equipment, gears, worm wheels, welding jaws, bushings, valve seats, etc.

Grade 20; copper 83.13, aluminum 12.40, iron 4.07, special agents .40, brinell 235; for cams, rollers, hard bushings, wear plates, etc.

Grade 21; copper 82.34, aluminum 13.02, iron 4.14; special agents .50; brinell 295; for form and draw dies, bushings on nitrided shafts, pressed gears, valves, shoes, welder clamps, etc.

Grade 22; copper 81.67, aluminum 13.42, iron 4.41; special agents .50; brinell 330; for drawing dies, conveyor pins, expanders, forming and drawing dies for heavy gage stock, wear strips, boring bar guides, ways, cam rollers, etc.

For further information see ad. on page 35D.

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ANTACIRON—Antaciron Inc., Wellsville, N. Y.; corrosion and abrasion resistant material furnished in form of finished castings; silicon 14.5, iron 85; brinell hardness 425.

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APEX—Apex Smelting Co., Chicago. A series of zinc base die cast alloys.

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APOLLOY METAL — Apollo Steel Co., Apollo, Pa. Carbon 0.08, manganese 0.40, sulphur 0.025, phosphorus under 0.045, copper 0.25 per cent; in sheets.

1 2 3 4 5 - 7 - -

ARMCO—American Rolling Mill Co., Middletown, O.

1 2 - 4 - - - - -

Grade 18-8 (type 302, 304); 19-9 (type 305, 306); 18-12 (type 316); 25-12 (type 309); 17 (type 430); RA (type 434A); 13 (type 410); 17-7 (type 301X) and 27 (type 446); these can all be drawn and stamped; all machinable and weldable.

1 - 3 4 - - - - -

Armco H. T.—50; high tensile steel; low carbon-nickel-phosphorus steel containing molybdenum. Supplied in sheets, strips and plates; suitable for stamping and welding.

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Tran-Cor 60; high silicon steel for distribution transformers. Grade 66; steel sheets with low core loss, for power and distribution transformers. Grade 72; a high silicon steel for large generators and general transformer work.

Intermediate Transformer; scale-free silicon steel sheet for some transformer and special applications.

Special Electric; scale-free medium steel sheet for a.c. motors and generators.

Electric; special analysis sheet for rotating machines.

Armature; steel sheet for small d.c. motors.

Field Grade; special sheet for intermittent duty fractional horsepower motors.

Radio No. 6; for applications in which superior low induction magnetic characteristics are important. No. 5; for audio transformer cores and other low induction applications. No. 4; good permeability at low induction; for chokes. Nos. 3, 2 and 1; for small transformers.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

Ingot Iron; highly refined iron for magnetic cores; supplied in round and flat bar form.

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Armco Ingot Iron; highly refined iron supplied in galvanized sheet for general sheet metal work; also hot rolled annealed and cold rolled sheets, plates and strip.

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Armco Enameling Iron; highly refined iron for enameling purposes; supplied in sheets.

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AR STEEL—Carnegie-Illinois Steel Corp., Pittsburgh. Carbon .35 to .50, manganese 1.50 to 2, phosphorus .05 max., sulphur .055 max., silicon .15 to .30, and copper .20 min. if desired; brinell hardness 200 to 250; tensile strength 100,000 to 125,000 pounds per square inch; for fan blades, chute linings, conveyor troughs, and wearing plates where abrasion is encountered.
For further information see ad. on page 3D.

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ASARCOLOY No. 7—American Smelting & Refining Co., New York. A cadmium-nickel bearing alloy capable of withstanding high compression loads and high operating temperatures.

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ATLAS—Ampco Metal Inc., Milwaukee.

1 - - **4** - **6** - - -

Grade 89; copper 88.5, aluminum 10, iron 1, special agents .5; brinell hardness 70 untreated, 120 to 140 heat treated; resists sulphuric, hydrochloric, nitric and other acids, also pickling solutions, water and brines; for gears, heavy bearing bushings, acid equipment, welding jaws, and steel mill service.

1 - - **4** - - - - -

Grade 89-H. T.; copper 88.5, aluminum 10, iron 1, special agents 5; brinell hardness 80 untreated, 160 to 180 heat treated; resists sulfuric, hydrochloric, nitric and other acids, caustic and pickling solutions, water and brines. Material has compressive strength of 170,000 pounds.
For further information see ad. on page 35D.

- - **3 4** - - - **8** -

ATLAS No. 93—Ludlum Steel Co., Watervliet, N. Y. Carbon, 0.55, chromium 0.65, molybdenum 0.35; for collets, studs and parts requiring toughness in hardened condition. Oil hardening.

1 2 - **4** - - - - -

AUROMET—Aurora Metal Co., Aurora, Ill. Special aluminum bronzes of several compositions.

- **2** - - - - - - **9**

AVIALITE—American Brass Co., Waterbury, Conn. Copper-aluminum alloy for valve seats and guides in airplane motors.

1 - - **4 5** - - - **9**

AW—Alan Wood Steel Co., Conshohocken, Pa.

1 - - - - - - - **9**

70-90; type SSAA; copper-phosphorus alloy furnished in sheets and plates which has a tensile strength of 70,000 pounds per square inch; and resists industrial atmospheres; for lightweight parts.

1 - - **4 5** - - - -

70-90; type SSA; copper-phosphorus steel furnished in sheets and plates; resistant to industrial atmospheres; tensile strength of 90,000 pounds per square inch; recommended for lightweight construction.

B

1 2 - - - - - - - -

B. & W. CROLOY 2—Babcock & Wilcox Tube Co., Beaver Falls, Pa. carbon .15 max., chromium 1.75 to 2.25, molybdenum .40 to .60, silicon .50 max.; for refinery and superheater tubes.

5M; chromium molybdenum; 4 to 6 per cent chromium for oil refinery service.

9; carbon .15 max., chromium 8 to 10, molybdenum 1.25 to 1.75; semi-stainless alloy of good physical properties.

18-8S; low carbon; for high temperature work if no long heating is involved.

18-8; general purpose alloy similar to Croloy 18-8S low carbon except that for pressure service the temperature should not exceed 600 degrees Fahr.

16-13-3; austenitic type alloy similar in many respects to 18-8 and 25-20; high strength at elevated temperature—corrosion resistant.

25-20; chromium 25, nickel 20; has high strength and high oxidation resistance, also excellent corrosion resistance.

1 2 - **4** - - - - -

12; resistant to atmosphere and acids; resists heat up to 1500 degrees Fahr. and when heat treated has tensile strength of 180,000 pounds; supplied in form of tubing.

1 2 - - - - **7** - -

BAKER—Baker & Co. Inc., Newark, N. J. Platinum and alloys for linings, contacts, thermocouples, furnace resistors, etc.

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BEARITE—A. W. Cadman Mfg. Co., Pittsburgh; babbitt metal furnished in ingots and 50-pound pigs; brinell hardness 70 degrees Fahr.—29.1, 212 degrees Fahr. 24.4; compressive strength 15,000 per square inch; for rotary bearings subjected to heavy loads and or extreme speed.

1 - - **4** - **6** - - -

BEARIUM—Bearium Metals Corp., Rochester, N. Y.

1 - - - - **6** - - -

B-4; copper 70, tin 4, bearium processed lead 2; brinell hardness 40; resists corrosion due to high lead content; resists heat up to 700 degrees Fahr.; tensile strength 21,500 pounds; compressive strength 9750; for bearings and slides, guides, driving nuts, piston rings, packing rings.

1 - - **4** - **6** - - -

B-4 (High Strength); copper 70, tin 10, bearium processed lead 20; brinell hardness is 55 untreated; resists corrosion due to high lead content; withstands heat up to 700 degrees Fahr.; tensile strength 25,500 pounds; compressive strength 11,800.

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BELMALLOY—Belle City Malleable Iron Co., Racine, Wis. Pearlitic malleable iron, electric furnace melted and continuous oven annealed; for castings of machining quality, requiring strength and shock resistance.

1 2 - - - - - - - -

BETHADUR—Bethlehem Steel Co., Bethlehem, Pa. Steels of the designated characteristics for virtually all purposes except those calling for free machining. This tradename covers 43 different corrosion resistant alloying steels adaptable for machinery in the chemical industries, oil refining, mining and metallurgy, the paper industry, the food industry, etc. The following are typical examples:

No. 302, 17 to 19 chromium, 7 to 9.50 nickel, .08 to .20 carbon.

No. 304; 17 to 19 chromium, 7 to 8.50 nickel, .11 max. carbon.

No. 305; 18 to 20 chromium, 8 to 10 nickel, .08 to .2 carbon.

No. 306; 18 to 20 chromium, 8 to 10 nickel, .11 max. carbon.

No. 307; 19 to 22 chromium, 9 to 12 nickel, 0.8 to .2 carbon.

No. 308; 19 to 22 chromium, 9 to 12 nickel, .11 max. carbon.

No. 403; 11.5 to 13 chromium, .12 max. carbon.

No. 410; 10 to 13.5 chromium, .12 max. carbon.

No. 420; 12 to 14 chromium, .12 min. carbon.

No. 430; 14 to 18 chromium, .12 max. carbon.

No. 440; 14 to 18 chromium, .12 min. carbon.

No. 442; 18 to 23 chromium, .35 max. carbon.

No. 446; 23 to 30 chromium, .35 max. carbon.

No. 501; 4 to 6 chromium, .1 min. carbon.

No. 502; 4 to 6 chromium, .1 min. carbon.

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BETHALON—Bethlehem Steel Co., Bethlehem, Pa. Free machining high chromium steel for variety of machine parts. Two typical grades are the following:

No. 303; 17 to 19 chromium, 7 to 9.50 nickel, .20 max. carbon, .15 min. or .60 max. sulphur or selenium.

No. 416; 12 to 14 chromium, .12 max. carbon, .15 min. or .60 max. sulphur or selenium.

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BETH-CU-LOY—Bethlehem Steel Co. Inc., Bethlehem, Pa. A copper bearing steel resistant to atmospheric corrosion; for jackets, covers, machine guards, oil pans, etc.

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BETHLEHEM—Bethlehem Steel Co. Inc., Bethlehem, Pa.

- - **3** - - - - - -

Nos. 235 and 300; abrasion resisting, high-carbon-manganese-silicon steels of 235 and 300 brinell respectively; for shovels, crushers, hoppers, scraper blades and conveyors.

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Nos. 6 and 7; nickel steels containing 35 and 40 per cent nickel respectively; have low coefficient of expansion; for scientific and measuring instruments and for control equipment.

- - - - - **6 7** - -

BETHLEHEM—Bethlehem Steel Co. Inc., Bethlehem, Pa.

- - - - - **6** - - -

Bearing steels; high carbon steels in three grades, namely; "Standard" chromium steel, "H. T. W." chromium-vanadium steel, and "Moly" chromium-molybdenum steel. All grades are processed to meet requirements of bearings for automotive and industrial service. Other uses include injector parts for diesel engines.

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Magnet steels; high carbon steels with varying chromium content, up to 6 per cent. Permanent magnet No. 1, a 6 per cent tungsten steel; Cobaflux, a high cobalt steel used for magnets in meters, telephones, magnetos and other electrical equipment.

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BETHLEHEM 88-80—Bethlehem Steel Co. Inc., Bethlehem, Pa.; chromium molybdenum steel castings with high abrasion resistance for ball mill liners, rolls, tires, bottom plates, etc.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

- 2 - - - - 7 8 -

BIMETAL—W. M. Chace Co., Detroit. Thermostatic bimetals; a number of combinations including alloys of nickel-iron, nickel-iron-chromium, nickel-iron-manganese, pure nickel, brass, bronze, etc.; responsive to various temperature ranges and provide a wide range of deflection rates and electrical resistivities; for temperature control elements in controllers, recorders, indicators, circuit breakers, etc.

1 2 - 4 - - - - -

BIRDSBORO—Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.

No. 26; high physical properties including high tensile strength; resists corrosion because of copper content; for dredge castings and other castings subject to high stress.

No. 30; resists corrosion due to its copper and .25 molybdenum content. Recommended for dredge castings and other castings subject to high stress.

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BLACKOR—Blackor Co., Los Angeles. Tungsten carbide specially processed for electric arc welding application in grading and agricultural machinery, coal mining equipment, for airplane skid shoes and other uses where resistance to abrasion is primary consideration.

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BOHNALITE—Bohn Aluminum & Brass Corp., Detroit. Light alloy of which aluminum is the base; for forged connecting rods, cast cylinder heads, crankcases, transmission cases, and parts for vacuum cleaners, washing machines, shoe machinery, etc.

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BONNEY-FLOYD—Bonney-Floyd Co., Columbus, O. Annealed, normalized and quenched and tempered carbon and alloy steels for general purposes.

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BORIUM—Stoody Co., Whittier, Calif. Tungsten carbide metal used chiefly as inserts in rotary drilling tools as substitute for diamonds.

Tube Borium and Borod; made up of steel tubing containing fine particles of Borium; used as overlays on earth working equipment.

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BOUND BROOK — Bound Brook Oilless Bearing Co., Bound Brook, N. J. Graphite and bronze bushings, bearings and washers.

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BRASTIL—Doehler Die Casting Co., New York. Copper base alloy containing more than 81 per cent copper; has high strength and hardness, high resistance to fatigue, shock and corrosion, with good bearing qualities; for die cast parts; pale gold in color.

1 - - - 5 - - - -

BRIDGEPORT COPPER AND ZINC ALLOYS—Bridgeport Brass Co., Bridgeport, Conn.

Yellow brass; copper 65 per cent, zinc 35 per cent; sheet, wire and seamless tubing for drawing, stampings, and cold heading.

Free cutting brass rod; copper 60 per cent, lead 3 per cent, zinc balance; for making automatic screw machine parts.

Low brass; copper 80 per cent, zinc 20 per cent; pale golden color; for articles requiring greater ductility and malleability than possessed by yellow brass.

Commercial bronze; copper 90 per cent, zinc 10 per cent; bronze color for manufacturing stampings and drawn items and cold headed items, for outdoor use; stands weathering better than yellow brass; copper sheet, rod, wire, seamless tubing for miscellaneous manufacturing.

Phosphor bronze; copper 92 per cent, tin 8 per cent; spring quality for manufacturing spring parts; has better spring properties than 95 per cent and 5 per cent.

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Phosphor bronze; copper 95 per cent, tin 5 per cent; sheet spring quality for manufacturing switch parts.

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BUNTING—Bunting Brass & Bronze Co., Toledo. A line of some 160 bearing bronzes including the following:

Low lead bronze alloys:

Alloy No. 27; copper 80, tin 10, lead 10.

Alloy No. 72; copper 83, tin 7, lead 7, zinc 3.

Alloy No. 124; copper 85, tin 5, lead 9, zinc 1.

Medium to high bronze alloys.

Alloy No. 125; copper 75, tin 5, lead 20.

Alloy No. 135; copper 77, tin 8, lead 15.

Alloy No. 158; copper 70, tin 5, lead 25.

Alloy No. 161; copper 63, tin, 2, lead 35.

Alloy No. 162; copper 70, tin 9, lead 21.

Hard phosphor bronzes:

Alloy No. 51; copper 86.5, tin 10, lead 1.5, zinc 2.

Alloy No. 96; copper 87, tin 10, lead 3.

Alloy No. 98; copper 88, tin 10, zinc 2.

Alloy No. 156; copper 90, tin 10.

Alloy No. 164; copper 87, tin 11, lead 1, nickel 1.

Babbitts:

Alloy No. 116; copper 6, tin 87, antimony 7.

Alloy No. 170; tin, 10, lead 75, antimony 15.

For further information see ad. on page 41D.

C

1 2 3 - - - - - - -

CALITE—The Calorizing Co., Pittsburgh. Type A; nickel-chromium-iron alloy available in the form of castings and rolled bar stock; readily machinable.

Type B; cast form only for oil refining industry.

Type B-28; available as castings, sheet and bar stock; possesses extreme stiffness at all temperatures and has corrosion resistance, high creep strength and permanent ductility.

Type N; nickel-chromium-iron in sheets, bars, castings.

Type S; malleable alloy steel; greatest utility in form of hot rolled sheets for corrosion work at moderate temperatures; may be flanged, punched or assembled by welding.

Type E; a malleable alloy steel in form of bars and sheets; not affected by weather corrosion, sulphur compounds and many organic acids and inorganic salts.

Calite-Nirosta stainless steels in cast form.

Calorized Steel—Tubes, bars, plates and pots.

- 2 3 4 - - - - -

CANNONITE—Campbell, Wyant & Cannon Foundry Co., Muskegon Heights, Mich. Electric furnace high test cast iron; total carbon 2.75 to 3; for diesel and auto cylinders, centrifugal sleeves and brake drums, gas-tight castings, presses, dies, etc.

1 - 3 - - - - - -

CARBOLOY—Carboloy Co. Inc., Detroit. A cemented carbide that has high resistance to abrasive and corrosive wear; rockwells as high as 93 on the A scale; for wear resistant inserts to impart longer life to parts such as cams, cam followers, hydraulic valve stems and seats, machine tool rests, etc.

1 2 3 - - - - - -

CARBOLOY—Carboloy Co., Detroit. A cemented carbide, formula varies according to use embodying tungsten carbide, titanium carbide and cobalt; outstanding on account of its extreme hardness, compressive strength being as high as 890,000 pounds per square inch; Rockwell hardness on "A" scale 87 to 92; does not rust or corrode under normal conditions; in addition to use for high-speed cutting tools, material is recommended for machine parts subject to extreme wear.

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CARBOMANG—Detroit Alloy Steel Co., Detroit. Carbon 0.9 to 1; manganese 1 to 1.10, chromium 0.40 to 0.60; oil hardening tool steel castings.

1 2 3 4 5 6 7 - -

CARPENTER—The Carpenter Steel Co., Reading, Pa.

1 2 - 4 5 - - - -

No. 1 stainless bar steel; carbon .10, chromium 12; for valve trim, turbine heat-treated parts.

1 2 - - 5 - - - -

No. D-1 stainless strip and wire; carbon .10, chromium 15 to 16; for stampings, moldings, cold headed screws, rivets, etc.

1 - 3 4 - - - - -

No. 2; carbon .3, chromium 13; used in fully hardened conditioned for ball bearings, ball check valves, cutlery, instruments, etc.

No. 2B; carbon 1.00, chromium 17; uses same as No. 2.

1 2 - - - - - - -

No. 3; carbon .3, chromium 20, copper 1; for special chemical apparatus and scale resisting parts.

1 2 - 4 - - - - -

No. 4; carbon .10, chromium 18, nickel 9; for rolled moldings, stampings, etc.; also has high ductility.

1 2 3 - - - - - -

No. 5; carbon .10, chromium 14, sulphur .30; a free machining grade for automatic screw machine parts, valve trim, pump shafts, etc.

1 - - 4 5 - - - -

No. 6; carbon .10, chromium 16 to 18; uses same as No. D-1 and No. 4.

1 2 3 - - 6 - - -

No. 8; carbon .10, chromium 18, nickel 9, selenium .25; a free machining grade.

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N-30; 30 per cent nickel; nonmagnetic, for electrical parts requiring special thermal expansion properties.

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Chrome magnet steel; carbon .95, chromium 3.50; for magnets in meters and other electrical apparatus.

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Presto; carbon 1.05, chromium 1.40; for ball and roller bearings.

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Silico-manganese steel; carbon .60, manganese .75, silicon 2; for heavy duty springs.

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CAST ALLOY STEEL—The Alloy Cast Steel Co., Marion, O.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

- - - 4 - - - - - -

Nickel steel castings; carbon .30-.40, manganese .60 to .80, sulphur .05 max., phosphorus .045 max., silicon .35 to .45, and nickel 3.25 to 3.75; has high strength and resistance to shock and fatigue; used largely in annealed condition, although responds to heat treatment.

- - 3 4 - - - - - -

Nickel chrome steel castings; carbon .35 to .45, manganese .60 to .80, phosphorus .045 max., sulphur .05 max., silicon .35 to .45, nickel 1.50 to 2.00, and chromium .60 to .75; has high strength and wear resistance.

- - 3 4 - - - 8 -

Nickel chrome molybdenum steel castings; carbon .35 to .45, manganese .60 to .80, phosphorus .045 max., sulphur .050 max., silicon .35 to .45, nickel 1.50 to 2.00, chrome .60 to .75, and molybdenum .25 to .45; used in parts which must be strong and hard and where size or shape prevent liquid quenching.

- - 3 4 - - - 8 -

Manganese molybdenum steel castings; carbon .30 to .40, manganese 1.25 to 1.60, phosphorus .045 max., sulphur .050 max., silicon .35 to .45 and molybdenum .25 to .45; used for gears, sprockets, levers, etc.

- - 3 4 - - - - - -

Medium manganese steel castings; carbon .30 to .40, manganese 1.25 to 1.50, phosphorus .045 max., sulphur .050 max., and silicon .35 to .45; used in power shovels, tractors, road machinery, etc.

- - 3 4 - - - - - -

High manganese steel castings; carbon 1.10 to 1.30, manganese 10.50 to 13.50, phosphorus .10 and under; tensile strength, 80,000 to 90,000; yield, 40,000 to 50,000; cannot be machined readily and is usually finished by grinding.

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CASTALOY—Detroit Alloy Steel Co., Detroit. Chromium 12 to 14, carbon 1.5 to 1.6; air hardening tool steel castings.

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CATARACT METAL—Niagara Falls Smelting & Refining Corp., Buffalo. Nickel copper for introduction into alloy casting metal.

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CECOLLOY—Chambersburg Engineering Co., Chambersburg, Pa.

- - 3 4 - - - - - -

A; carbon 3.00; molybdenum .50, nickel .60; shock resistance, vibration damping, and close grain.

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B; carbon 2.80, molybdenum .50, chromium .35; also has shock resistance, is vibration damping and has close grain in heavy sections.

- - 3 4 - 6 - - - -

C; carbon 3.00, molybdenum .50, nickel 1.50; properties similar to type A.

1 - - 4 - 6 - - - -

CECOLLOY IRON—Chambersburg Engineering Co., Chambersburg, Pa.; carbon .30, manganese .90, silicon 1.30, nickel 60, molybdenum .50; suitable for casting in cement-bonded sand molds; resists corrosion to atmospheric conditions and acids; has tensile strength 56,000 pounds per square inch; brinell hardness of 255; for steam cylinder liners, cylinders, rings and valves; also beds for heavy duty machine tools.

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CERROBASE—Cerro de Pasco Copper Corp., New York. A Bismuth-lead-casting alloy which expands on cooling; recommended for master patterns, electroforming, engraving machine models, etc.

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CERROBEND—Cerro de Pasco Copper Corp., New York. A Bismuth-lead-tin-cadmium casting alloy which expands on cooling and has the extremely low melting temperature of 160 degrees Fahr., useful as a fusible alloy and as a filler for tube bending.

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CERROMATRIX—Cerro de Pasco Copper Corp., New York. A Bismuth-lead-tin-antimony casting alloy which melts at 240 degrees Fahr. and expands on cooling; used for locating and anchoring machine parts in cored holes.

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CHAMET BRONZE—Chase Brass & Copper Co. Inc., Waterbury, Conn. Copper 60, tin .75, zinc 39.25; for general use where strong corrosion resistant brass is required.

1 - - 4 5 - - - - -

CHASE—Chase Brass & Copper Co. Inc., Waterbury, Conn.

Free-cutting commercial bronze; copper 89, lead 2, zinc 9; for screw machine parts requiring good physical properties and high corrosion resistance.

Nickel aluminum bronze; copper 92, nickel 4, aluminum 4; principally corrosion resistant; particularly recommended for condenser tubes in oil refineries or where temperatures are not higher than in the usual surface condensers.

Also various high and low brasses for a variety of mechanical parts.

1 2 - - - - - - 8 -

CHROMAX—Driver-Harris Co., Harrison, N. J.; a heat resisting alloy used for carburizing containers or furnace parts; nickel 35, chromium 19, and balance iron.

- 2 - - - - 7 - -

CHROMEL——Hoskins Mfg. Co., Detroit.

- 2 - - - - - - - -

No. 502; 18 to 22 chromium, 30 to 34 nickel, balance mainly iron; for burning tools in the enameling industry and for metal furnace parts.

- 2 - - - - 7 - -

Grade A; nickel 80, chromium 20; for electric heating elements.

1 2 - - - - - - - -

CIMET—Driver-Harris Co., Harrison, N. J. Nickel 10 to 12, chromium 26-28, and balance iron; castings for furnace parts in high sulphur atmospheres, and for acid resisting castings in the form of pump impellers, piping, etc.

1 2 3 4 5 - - - - -

CIRCLE L—Lebanon Steel Foundry, Lebanon, Pa. This trade name covers forty-three different types of alloys including the following:

- - - 4 5 - - - - -

No. 1; manganese 1.40, carbon .35, with vanadium or molybdenum.

- - 3 4 5 - - - - -

No. 2; carbon .32, chromium .75, molybdenum .30, manganese 1.40; for crankshafts, airplane parts, valves, and other castings.

- - 3 4 - - - - - -

No. 3; carbon .50, chromium 1.25, vanadium .12, molybdenum .40, manganese 1.40; for gears and cams.

- - 3 - - - - - - -

No. 4; carbon .50 to .80, chromium 1.25 to 2.00, manganese 1.0 to 1.50, vanadium .12, molybdenum .50 to 1; for cams, rolls, etc.

- - 3 4 - - - - - -

No. 6; carbon .5, nickel 1.75, molybdenum .25; for cams, gears and other case hardened parts.

- - 3 4 - - - - - -

No. 8; carbon .20, chromium 2.75, molybdenum .40, vanadium .22; nitriding steel.

1 2 - 4 - - - - - -

No. 10; carbon .20, chromium 5.50, molybdenum .55; for high pressure and high temperature applications in the oil industry.

1 - 3 - - - - - - -

No. 11; carbon .75, chromium 18; hard stainless steel; for sand pumps, etc.

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No. 12; carbon .10, chromium 13; stainless steel; chemical apparatus, etc.

1 2 - - - - - - - -

No. 15; carbon .30, chromium 27; heat and corrosion service.

1 2 - - - - - - - -

No. 22; carbon .07 max., chromium 19.50, nickel 9; for miscellaneous stainless parts and castings to be polished.

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No. 23; carbon .15, chromium 19.50, nickel 9; miscellaneous stainless steel castings.

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No. 24; carbon .15; chromium 9, nickel 19.50; stainless steel.

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No. 25; carbon .15, chromium 21; nickel 10; for valves and pump parts for the paper industry.

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No. 30; carbon .15, chromium 24, nickel 10; uses same as No. 25.

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No. 31; carbon .22, chromium 22, nickel 11; resistant to temperatures up to 2000 degrees Fahr.

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No. 32; carbon .50, chromium 15, nickel 35; heat resisting castings requiring strength at elevated temperatures.

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CLOVERLEAF—E. A. Williams & Son Inc., Jersey City, N. J. Babbitt metal in grades A, B and 0 and 1, 2, 3 and 4, for bushings, bearings, etc.

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COLMONOY—Colmonoy Inc., Los Nietos, Calif.

No. 2; alloy for castings and overlays which resists corrosion due to its chromium-boron content; resists heat up to 1600 degrees Fahr.; has high abrasion resistance, its brinell hardness being 600, and excellent welding qualities; for machine parts where heat and abrasion will be encountered.

No. 3; alloy for castings and overlays which resists corrosion due to chromium-boron-tungsten content; resists heat up to 2000 degrees Fahr.; has high abrasion, its brinell hardness being 650, and excellent welding qualities; recommended for machine parts which must withstand impact.

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No. 6; alloy for castings and overlays which resists corrosion due to its nickel-chromium and boron content; resists heat up to 1600 degrees Fahr.; has high abrasion resistance, its brinell hardness being 550 to 600, and

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

excellent welding qualities; for machine parts where heat and abrasion will be encountered.

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COLUMBIA—Columbia Steel & Shafting Co., Pittsburgh; furnished in rods and bars; tensile strength is high; bearing properties are good; and material machines freely.

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COMMERCIAL—Buckeye Brass & Mfg. Co., Cleveland. Cored and solid bronze bars; copper 80, tin 10, lead 10; for bushings, bearings and bars.

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COMPO—Bound Brook Oil-less Bearing Co., Bound Brook, N. J. Self-lubricating bushings, bearings and washers.

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COOPER ALLOY—(Formerly Sweetaloy)—Cooper Alloy Foundry Co., Elizabeth, N. J.

No. 16; 18 per cent chromium iron.

No. 17; 18 chromium and 8 per cent nickel.

No. 18; 22 nickel and 10 chromium.

No. 19; 28 per cent chromium.

No. 20; 36 nickel and 18 chromium.

No. 21; 65 nickel and 15 chromium.

No. 22; 28 chromium and 10 nickel; this and above alloys furnished in castings for chemical plant, paper mill, textile and food processing machinery.

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COP-R-LOY—Wheeling Steel Corp., Wheeling, W. Va. Mild steel containing small percentage of copper. Recommended for boiler tubes, pipes, and fabricating requirements where sheets are used.

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COR-TEN—United States Steel Corp. and subsidiaries (See USS). A low alloy-phosphorus-silicon-copper-chrome steel resistant to atmospheric and salt water corrosion with brinell hardness 140 to 180; recommended for lightweight parts where durability is a factor.

For further information see ads. on pages 3D and 37D.

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CORVIC BRONZE—Chase Brass & Copper Co., Waterbury, Conn. Copper 98.5, tin 1.5; rod and wire.

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CROMANSIL — Carnegie-Illinois Steel Corp., Pittsburgh, and Lukens Steel Co., Coatesville, Pa. Carbon .35 max., manganese .90 to 1.50, phosphorus .04 max., sulphur .05 max., silicon .60 to .90, chromium .30 to .70; for high strength construction such as ships, boilers, towers, machine frames, etc. For further information see ad. on page 3D.

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CROMIN D—Wilbur B. Driver Co., Newark, N. J. Nickel-chromium-iron; high resistivity, for use in low temperature work.

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CROMONITE — Continental Roll & Steel Foundry Co., East Chicago, Ind. Hard alloy chill roll made in three grades, mild, medium and hard; for special appliances.

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CUMLOY—West Steel Casting Co., Cleveland; a molybdenum-vanadium-nickel alloy for steel castings such as cams, gears, levers, and indexing mechanism parts.

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CUPALOY—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Copper base alloy containing chromium and silver; thermal and electrical conductivity 80 to 90 per cent of pure copper; tensile properties of steel; brinell hardness up to 140-160; applications include spot-welding tips, seam-welding wheels and rolls, mechanical parts carrying heavy current, etc.

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CUPRON—Wilbur B. Driver Co., Newark, N. J. Nickel copper alloy; supplied in wire and strip form; for rheostats, voltmeters, shunts and other resistances operated below red heat; has moderate resistivity; resists heat up to 1000 degrees Fahr.

1 2 - 4 - - 7 - -

CUSILOY—Scovill Mfg. Co., Waterbury, Conn.

1 2 - 4 - - - - -

Grade 218(A); copper 95.5, silicon 3, iron 1, tin .5; rod and wire.

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Grade 626(B); copper 96.75, silicon 1, iron .75, tin 1.5; rod and wire.

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CYCLOPS — Universal-Cyclops Steel Co., Titusville, Pa.

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No. 17-A Metal, (Type No. 325); nickel 20, chromium 8; also has high strength and ductility; for turbine blading, high pressure valves and electrical applications—nonmagnetic.

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K-Rustless (Type No. 439); chrome 8, tungsten 8, carbon 0.60: is heat resisting; has bearing and cutlery application.

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CYCLOPS ORION—Universal-Cyclops Steel Co., Titusville, Pa. Chrome vanadium steel for machine parts.

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CYCLOPS WANDO — Universal-Cyclops Steel Co., Titusville, Pa. Carbon 0.95, manganese 1.05, chromium 0.50, tungsten 0.50, vanadium 0.20; oil hardening, nonshrinking tool and die steel.

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DAVIS METAL—Chapman Valve Mfg. Co., Indian Orchard, Mass. Corrosion resisting iron; carbon and silicon 0.5, manganese 1.5, nickel 29, iron 2, copper 67 per cent; for valves and fittings.

1 2 - 4 - - - - -

DEFIHEAT—Rustless Iron & Steel Corp., Baltimore. Carbon .35 max., chromium 23 to 30; resists nitric and sulphuric acids, also heat up to 2000 degrees Fahr.; for furnace parts and other applications involving high heat.

1 2 - 4 - - - - -

DEFIRUST—Rustless Iron & Steel Corp., Baltimore.

No. 410 stainless type; carbon .12 max., chromium 10 to 13.5; hardening type of stainless steel for turbine blades.

No. 416 machining type; carbon .12 max., sulphur .5 and chromium 12 to 14; hardening type of stainless steel possessing free cutting properties.

1 2 - 4 - - - - -

DEFISTAIN—Rustless Iron & Steel Corp., Baltimore.

Types 302, 304 and 308; carbon .082 to .12 max. and .08 max., manganese .25 to .6, chromium 17 to 20 nickel 7 to 10; retains high tensile strength and resistance to creep up to 1300 degrees Fahr.; nonmagnetic resists nitric acid, salt air, and food; resists heat up to 1600 degrees Fahr.; recommended for machinery parts which come in contact with food.

Type 303, machining; carbon .15, sulphur .15, chromium 17 to 19 and nickel 7 to 9.5; also has high ductility and free cutting properties; resists heat up to 1550 degrees Fahr. and has tensile strength up to 200,000 pounds per square inch; recommended for same purposes as above where free cutting is desirable.

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DEWARD—Ludlum Steel Co., Watervliet, N. Y. Carbon 0.9, manganese 1.50, molybdenum 0.30; for holders for thread chasers and gang punches. Oil hardening.

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DIAMITE—Weatherly Foundry & Mfg. Co., Weatherly, Pa. Nickel 4-6, chromium 2-3 per cent, an abrasion-resisting, sand-casting material suitable for parts of pulverizing machinery.

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DIAMOND G BRONZE—E. A. Williams & Son Inc., Jersey City, N. J. for bearings, bushings and mill brasses, either finished or in the rough.

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DM STEEL—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O. Carbon under 0.15, manganese 0.30 to 0.60, silicon 0.75 to 1.25, chrome 1 to 1.50, molybdenum 0.40 to 0.60, phosphorus 0.04 max., sulphur 0.04 max., good resistance to creep up to 1200 degrees Fahr.; for power and refinery equipment such as tubing.

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DOLER ALCULOY—Doehler Die Casting Co., New York; copper 7, silicon 2.5, and remainder aluminum; an inexpensive alloy, but it cannot be used in all parts.

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DOLER ALSILOY—Doehler Die Casting Co., New York.

No. 1; silicon 12, and remainder aluminum; has the best casting properties and must be used for certain large castings.

No. 3; copper 4, silicon 5, and remainder aluminum; in physical properties and cost, this material is in between ALCULOY and ALSILOY NO. 1.

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DOLER-BRASS—Doehler Die Casting Co., New York. Copper-zinc-silicon alloy; yellow metal; for die cast machine parts.

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DOLER-MAG—Doehler Die Casting Co., New York.

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No. 2; aluminum 2, manganese .2, silicon .2 and remainder magnesium.

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No. 6; aluminum 6, manganese .2, silicon .2 and remainder magnesium; is marked for its fair casting properties.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

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No. 10; aluminum 10, manganese .2, silicon .5, and remainder magnesium; has high tensile strength, yield point and hardness and best casting properties.

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DOLER-NIKLBRASS — Doehler Die Casting Co., New York. Copper base alloy containing nickel and manganese; white with slightly yellow tinge; for die castings.

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DOLER-ZINK—Doehler Die Casting Co., New York.

No. 2; a zinc base alloy containing copper 2.7, aluminum 4.1, magnesium .03 and remainder zinc.

No. 3; aluminum 4.1, magnesium .04 and remainder zinc; best for high impact.

No. 5; copper 1.0, aluminum 4.1, magnesium .03, and remainder zinc; good where impact and strength are desired.

1 . . 4 9

DOWMETAL—Dow Chemical Co., Midland, Mich.

Alloy F; aluminum 4, manganese .20, and magnesium remainder; tubing, sheets, strip and plates; excellent weldability for aircraft and transportation industry.

Alloy H; aluminum 6, manganese 1.5, zinc 3, and magnesium remainder; sand castings for aircraft and portable machinery with improved salt water corrosion resistance; may be heat treated to secure high yield and ultimate strengths with good impact toughness.

Alloy K; magnesium 89.4, aluminum 10, manganese .1, silicon .5; die castings; may be heat treated to increase impact toughness with slight reduction in yield strength.

Alloy M; manganese 1.20, magnesium remainder; furnished in sheets and strips for special applications for moderately stressed parts such as cover plates requiring resistance to salt water.

Alloy L; magnesium 93.8, aluminum 2.5, cadmium 3.5, manganese .2; hammer forgings for aircraft and transportation industries.

Alloy O; magnesium 90.8, aluminum 8.5, manganese .18, zinc .5; press forgings, bars, and extruded shapes for highly stressed parts of simple design.

Alloy X; magnesium 93.8, aluminum 3.0, manganese .2, zinc 3.0; press forgings, bars, and extruded shapes, a good combination of properties and salt water resistance, may be aged to increase yield strength. Recommended for rotating and reciprocating where light weight is advantageous.

For further information see ad. on page 47D.

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DUPLEX—Crucible Steel Co. of America, New York.

No. 1, nickel 3.50, chromium 1.50; forging steel; for shafts and machine parts requiring high strength and toughness; also made in case carburizing type.

No. 2; nickel 1.75, chromium 1; also a forging steel for applications similar to those of No. 1, and made in case carburizing type.

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DURACAST—West Steel Casting Co., Cleveland; for steel castings of 90,000 pounds per square inch tensile strength and brinell hardness of 180; for cams, gears, etc.

1 2 3 . . . . . .

DURALOY—Duraloy Co., New York.

1 2 3 . . . . . .

A; 27 to 30 chromium.

1 2 . . . . . .

B; 16 to 18 chromium.

C; 12 to 14 chromium.

N; 21 to 24 chromium, 12 nickel.

18-8; 18 chromium, 8 nickel.

15-35; 15 chromium, 35 nickel; for castings.

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DURCO — Duriron Co. Inc., Dayton, O. Alloy steels (KA2S, KA2SMo., etc.); 18 chrome, 8 nickel, carbon max. 0.07 per cent, and other standard as well as special analyses preferred by users; for pumps, valves, fittings, castings for corrosive service, etc.

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DUREX—Moraine Products Co., Dayton, O. Copper 85 to 88 per cent, tin 9.4 to 9.8, graphite 2 to 6; bearings for motors, washing machines, electric refrigerators, farm implements, automobiles, etc.

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DUQUESNE SPECIAL—Continental Roll & Steel Foundry Co., East Chicago, Ind. Chrome molybdenum steel for rolls subject to severe service; also for abrasive castings.

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DURICHLOR—Duriron Co. Inc., Dayton, O. Silicon 14, molybdenum 4, carbon 0.80, traces of phosphorus and sulphur, balance iron; for pumps, valves, pipe, castings for corrosive service, especially for hydrochloric acid and chloride solutions.

1 2 . . . . . .

DURIMET—Duriron Co. Inc., Dayton, O. Nickel 23, chromium 20, silicon, molybdenum and copper 5 approx., carbon 0.07 max., balance iron; for pumps, valves, bolts, nuts and castings for corrosive service, especially weak sulphuric acid.

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DURIRON—Duriron Co. Inc., Dayton, O., and licensees including Shawinigan Chemicals Ltd., Montreal, Que. Silicon 14.50, carbon 0.80, manganese 0.60, sulphur and phosphorus traces, balance iron; for pumps, valves, exhaust fans, mixing nozzles, and castings for handling acids and other corrosive liquids and gases.

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DURONZE ALLOYS—Bridgeport Brass Co., Bridgeport, Conn. High copper silicon bronzes alloyed with elements such as tin, iron, aluminum, etc.; possess high strength combined with fine corrosion resistance.

I; possesses excellent cold working properties; cold headed bolts and screws, average 100,000 pounds per square inch in tensile strength; available in rod, wire and sheet form.

II; hot rolled sheet for making range boilers, automatic heaters and storage tanks by either electric arc or oxyacetylene welding methods; cold rolled strip used as a substitute for phosphor bronze spring metal; rod and wire used for making hot headed bolts and screw products; supplied in sheet, rod, wire, tube and ingot forms.

III; supplied in rod only; tensile strength about 100,000 pounds per square inch; hot forgings, tensile strength about 90,000 pounds per square inch; free machining; excellent for making high strength forgings and screw machine products.

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IV; made into condenser tubes only; fine for resisting corrosion from aerated sea water.

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DUTCH BOY BABBITT—National Lead Co., New York. Analysis varies for different bearing applications.

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DYNAMIC STEEL — Continental Roll & Steel Foundry Co., East Chicago, Ind.

C-2; low carbon, manganese, nickel cast steel for parts requiring high physical properties; for tractor frames, locomotive castings, etc.

C-3; medium carbon, manganese, nickel cast steel for resisting wear after a preferential heat treatment; for sprockets, spindles, wheel centers, cross heads, etc.

C-6; high chromium cast steel for special abrasive and crushing work; for sand mills, rock crushers, etc.

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ECONOMET—General Alloys Co., Boston; nickel 30, chromium 10; resists heat up to 1800 degrees Fahr.; has tensile strength of 70,000 pounds per square inch; for castings subject to high temperatures.

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ECONOMO—Wheelock Lovejoy & Co. Inc., Cambridge, Mass. Carbon 0.20 and 0.50 with alloy of molybdenum; free machining; for machine tool parts.

ELECTROMET — Electro Metallurgical Sales Co., New York. A line of ferro-alloys and alloying elements of various analyses.

For further information see ad. on page 6D.

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ELINVAR—Produced by Acieries d'Imphy, France; marketed in United States and Canada by R. Y. Ferner Co., Boston. Alloy with low thermal coefficient of elasticity; nickel 33 to 35, iron 53 to 61, chromium 4 to 5, tungsten 1 to 3, manganese 0.5 to 2, silicon 0.5 to 2, carbon 0.5 to 2; for watch and instrument hairsprings and tuning forks.

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ELKALOY—P. R. Mallory & Co. Inc., Indianapolis. A primary alloy of copper for spot and seam welding aluminum and its alloys, unpickled hot rolled steel, terne plate, tin plate, galvanized iron and other materials. A direct substitute for copper, it handles like copper but is harder and lasts longer.

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ELKONITE—P. R. Mallory & Co. Inc., Indianapolis. Two definite classes of materials. One group based on copper and such refractory metals as tungsten, molybdenum and their carbides—combinations which produce material with good electrical conductivity and great wear-resistant qualities, for use as welding electrodes and contactors in oil-immersed circuit breakers. Another group is based on silver and refractory materials such as tungsten, molybdenum and their carbides, and has been developed primarily as a facing material for heavy duty electrical contacts and contactors for air breakers. This material can be used either in the form of a thin facing or as an insert with copper or copper alloy backing material.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

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ELVERITE—Babcock & Wilcox Co., New York. Special chilled iron castings; for tube mill linings, car wheels, jaw crushers, sprockets, etc.

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EMPIRE — Empire Steel Castings Inc., Reading, Pa. Alloy steel castings to all standard chrome-nickel specifications; also possess high strength and ductility, and are suitable for heat treating.

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ENDURIA—Bethlehem Steel Co., Bethlehem, Pa. Special carbon spring steel.

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ENDURO—Alloy Steel Div., Republic Steel Corp., Massillon, O. Stainless and heat resisting alloys.

Chromium-nickel group:

18-8; chromium 18, nickel 8, carbon .08 to .20; especially suited to resist atmospheric corrosion, and corrosion reagents; for dairy and chemical plant equipment, food and meat processing machinery, high strength light weight structural members, and for resistance to oxidation at elevated temperatures.

18-8 S; similar to 18-8 except carbon is kept under .08 which permits its use in welded equipment subject to service corrosion.

18-8 S Ti; 18-8 S to which titanium has been added for eliminating intergranular corrosion at high temperatures; used for airplane collector rings and exhaust manifolds.

18-8 S Cb; 18-8 S plus columbium; for applications similar to those for which 18-8 S Ti is recommended.

18-8 S Mo; 18-8 S plus 2 to 4 molybdenum; resistant to acids encountered in paper and pulp processes, woolen dyeing and in chemical and pharmaceutical industries; recommended for severe corrosive conditions; good fabricating and welding properties.

18-8 B; 18-8 and 2 to 3 silicon; for resistance to oxidation up to 1650 to 1700 degrees Fahr.; for annealing boxes, furnace parts, etc.

HCN; chromium 25, nickel 12; for resistance to oxidation up to 1950 degrees Fahr.; fabricates, machines, and welds readily.

NC-3; chromium 25, nickel 20 and silicon 2 max.; for maximum heat resistance.

Straight chromium group:

S-1; chromium 11.5 to 13, carbon .12 max., responds readily to heat treat ment and is recommended where strength, toughness and hardness are required; for pump shafts, valve seats and stems, nuts and bolts.

FC; free machining grade of S-1 analysis.

AA; chromium 15 to 18, carbon under .10; good corrosion resistance and heat resistant to 1600 degrees Fahr.; for bicycle fenders, oil burner parts, etc.

18-23; chromium 18 to 23; high heat resisting properties; for furnace parts, etc.

HC; chromium 23 to 28; heat resistant to 2100 degrees Fahr.

4-6 per cent; chromium 4 to 6 with several carbon ranges up to .25 and with or without addition of molybdenum or tungsten; corrosion and heat resistance considerably superior to that of carbon steels, and with excellent strength at high temperature; for oil refinery and furnace parts.

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ERMAL—Erie Malleable Iron Co., Erie, Pa. Close grained, high tensile, ductile iron; for all general castings.

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ERMALITE—Erie Malleable Iron Co., Erie, Pa. Wear resisting alloy iron; for gears, wearing plates, friction drums and other parts subject to high stresses or wear.

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EVANSTEEL — Chicago Steel Foundry Co., Chicago. Nickel 1 to 1½ per cent, chrome .65 to 1, carbon varies from .30 to .50, sometimes carries additions of vanadium or molybdenum; for castings such as passenger car buckles, tooth bases, sprockets, gears, high pressure valves, etc.

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EVERDUR—American Brass Co., Waterbury, Conn.

Grade A; copper 96, silicon 3, manganese 1; uses include tanks and sewage disposal apparatus.

Grade B; copper 98.25, silicon 1.50, manganese .25; easily fabricated by all methods including welding; used for tubes, bolts and screws.

Grade D; casting alloy; copper 90.94, manganese 1.01, silicon 4.

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FAHRITE—Ohio Steel Foundry Co., Springfield, O.

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N-1; carbon .40 max., nickel 35 to 38, chromium 15 to 18.

N-5; carbon .40., max., nickel 60 to 65, chromium 12 to 14; for mechanical furnace parts.

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N-2; carbon .25 max., chromium 18 to 20, nickel 8 to 10; for valves, pressure castings, etc.

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N-3; carbon .40 max., chromium 24 to 26, nickel 10 to 13; for mechanical furnace castings, etc.

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FARRELL'S 85—Farrell-Cheek Steel Co., Sandusky, O. Specially processed steel castings for resisting abrasion, and possessing high strength, toughness and rigidity; tensile strength is 150,000 pounds per square inch.

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FEDERAL-MOGUL — Federal-Mogul Corp., Detroit.

F1; a gear bronze suitable for heavily loaded piston pin bushings, etc.

F2; lead bronze for average bushing application.

F3; used largely as backs for babbitt-lined bearings.

F5; widely used for babbitt-lined bearing backs and for bushings where service is not severe.

F6; for average bushing applications.

F8; good casting and machining qualities.

F11; for piston pin bushings and other low speed, heavily loaded applications.

F13; suitable for many of the uses to which F1 is applied.

F15; has 20 per cent lead and may be used safely under adverse lubrication conditions.

F16; because of high lead content may be used where only occasional lubrication is possible.

F18; high lead alloy of good casting characteristics.

F19; strong ductile alloy of average hardness with bearing qualities corresponding to other low lead compositions.

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52 ALLOY—Driver-Harris Co., Harrison, N. J.; alloy of nickel and iron which has been successfully used for sealing in glass and in which process no coating is required prior to the operation.

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FIRE ARMOR—Michiana Products Corp., Michigan City, Ind. Nickel 65, chromium 20 per cent.

Type B; nickel 60, chromium 12 per cent.

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FIRTHITE—Firth-Sterling Steel Co., McKeesport, Pa. Hard metal composition of sintered carbides furnished in number of grades to form wearing surfaces or the edges of cutting tools.

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FLINTCAST—Pacific Foundry Co., San Francisco, Calif. An abrasion resisting iron.

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42 ALLOY—Driver-Harris Co., Harrison, N. J.; notable for its coefficient of linear expansion approximately that of different grades of glass.

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GOHI—Newport Rolling Mill Co., Newport, Ky Iron-copper alloy; carbon .02, manganese .025, sulphur .025, phosphorus .005, silicon .003, copper .25; for any sheet or plate application such as in ventilating systems, fabricated sheet metal parts, etc.

1 2 - - - 6 - - -

GRAPHITE—Graphite Metallizing Corp., Yonkers, N. Y.; graphite 50, balance copper or babbitt; furnished in finished rods, bars and tubing; for fabrication into self-lubricating bearings.

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GRAPHO—Lehigh Babbitt Co., Allentown, Pa.; a homogeneous mixture of graphite and babbitt which can be poured in the usual way; recommended for bearings subject to lubricating difficulties.

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GUNITE—Gunite Foundries Corp., Rockford, Ill. Low carbon high test cast iron; for brake drums, cylinders, dies, hydraulic castings and other machine parts.

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HALCOMB—Halcomb Steel Co., Syracuse, N. Y.

Stainless Steels, Grade A; chrome 12.5 Grade B; chrome 17.

Stainless Irons, FM2; chrome 12; for free machining corrosion resistant parts.

No. 12; chrome 12 to 13.

No. 16; chrome 15 to 16.

No. 18; chrome 18 to 20.

No. 24; chrome 24 to 26.

NCR-238 and Rezistal; stainless steels in various grades for corrosion and heat resistant parts.

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HARDTEM—Heppenstall Co., Pittsburgh.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

Carbon .5, nickel chrome molybdenum die steel; for die blocks, shafting, etc.

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HARDWARE BRONZE—Scovill Mfg. Co., Waterbury, Conn. Copper 89, lead 2, nickel 1, zinc 8; rod and wire.

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HARDWELD—Lincoln Electric Co., Cleveland. High carbon arc welding electrode having brinell of 225-488; provides dense, tough surface of moderate hardness to enable various steel parts to resist shock and abrasion; for locomotive or crane tire flanges, car wheels, etc.

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HASCROME—Haynes Stellite Co., Kokomo, Ind. Alloy of chromium, manganese and iron; castings, sheet and hard facing welding rod or parts subject to abrasion and impact.

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HASTELLOY—Haynes Stellite Co., Kokomo, Ind. For piping, tanks, pump parts, valves, vessels, etc.

A and B; nickel, molybdenum and iron.

C; nickel, molybdenum, chromium and iron.

D; nickel, silicon, copper and aluminum.

1 2 3 - - - - - -

HAYNES STELLITE—Haynes Stellite Co., Kokomo, Ind. Nonferrous cobalt-chromium-tungsten alloy for corrosion and wear-resistant castings, hard-facing welding-rod for parts subjected to abrasion or a combination of abrasion, heat and corrosion.

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HAYSTELLITE—Haynes Stellite Co., Kokomo, Ind. Cast tungsten carbide; for inserts and composite rod (welding rod) for oil-well drilling tools, dredge cutter blades, etc.

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HEPPENSTALL — Heppenstall Co., Pittsburgh. Grade 2C30; nickel-chrome-molybdenum steel, .3 carbon; for shafting where high torsional strength is required such as drop hammer piston rods.

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HERCULOY—Revere Copper & Brass Inc. New York. Silicon bronze; silicon 3.25 tin .50; balance copper; in addition to properties indicated, it is nonmagnetic; made in sheets, strip, plates, cold drawn rods, shafting, welding rod, forgings, ingot form for sand castings; for piston rods, shafting, electrical construction, etc.

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HIGH TEST—International Nickel Co. Inc., New York and licensees. Nickel 1 to 1.25, total carbon 2.75 to 3.15, manganese .60 to 1, silicon .9 to 1.10; nickel cast iron possessing high tensile strength; for brake drums, diesel engine liners and heads, paper and printing press rolls, and valve bodies.

For further information see ad. on page 5D.

1 - 3 4 - - - - -

HIOLOY—Ohio Steel Foundry Co., Springfield, O.

Type 0-3; carbon .35 max., nickel 1 to 1.75, chrome .40 to .80, molybdenum .20 to .30; parts for refinery equipment where strength is major consideration.

Type 0.4; carbon .32 max., chrome 4 to 6, molybdenum .50 to .65; for refinery fittings to resist corrosion.

Type 0-6; carbon .75 max., chrome .80 to 1.20, vanadium .15 to .22; for cement mill liners and screen plates, conveyor pipe for abrasive materials, sand mill parts, etc.; available in cast form.

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HIPERNIK—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. A magnetic alloy consisting of 50 per cent nickel and 49 iron; extremely ductile; developed for special magnetic properties at moderately low induction, primarily for radio applications; melting point is 1450 degrees Cent.; sometimes used for heater elements for high temperature furnaces with reducing atmospheres.

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HOYT BABBITT METAL — National Lead Co., New York. Analysis according to bearing application.

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HUBBARD SPECIAL—Continental Roll & Steel Foundry Co., East Chicago, Ind. Nickel chrome steel for wear resisting rolls, guides and miscellaneous castings.

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HYB-LUM — Sheet Aluminum Corp., Jackson, Mich. Corrosion resisting, general purpose alloy containing nickel, copper, manganese, silicon and pure aluminum.

Grade A; high strength; heat treating or non-heat treating.

Grade B; medium strength; heat treating or non-heat treating.

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HYBNICKEL — Victor Hybinette, Wilmington, Del.

Types A, B, C, D, R and S; a series of nickel-chrome alloys for heat and acid resistance.

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HYLASTIC—American Steel Foundries, Chicago. Carbon .35, manganese 1.50, vanadium .10 to .12, phosphorus and sulphur not over .05; also furnished with the addition of chromium where greater resistance to abrasion is desirable; for rolling mill machinery, automotive and railroad equipment, hammer mills and hydraulic machinery.

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HY-SPEED—Buckeye Brass & Mfg. Co., Cleveland. Copper 88, tin 7 and zinc 2 per cent; for bushings, bearings, bars.

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HYTEMCO—Driver-Harris Co., Harrison, N. J., alloy of nickel and iron characterized chiefly by its high temperature coefficient of electrical resistance; lends itself advantageously to uses requiring self regulation by temperature such as immersion heaters and heater pads.

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HY-TEN—Wheelock-Lovejoy & Co. Inc., Cambridge, Mass. Chrome-manganese-molybdenum and chrome-nickel-molybdenum alloys with carbon from .10 to 1.

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IDEALOY—Wellman Bronze & Aluminum Co., Cleveland. Copper-tin-zinc alloy for heavy duty bearings.

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ILLIUM—Burgess-Parr Co., Freeport, Ill.

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G; nickel 58, chromium 22, copper 7, aluminum 4 to 6, balance iron, tungsten and manganese; brinell hardness 170 to 220; for pumps, meters, chemical equipment and other parts subject to corrosion; resists heat up to 2200 degrees Fahr.; resists most corrosion solutions except chlorides and other halogens.

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R; nickel 58, chromium 21 to 23, copper 0 to 4, molybdenum 4 to 6, balance iron, tungsten and manganese; brinell hardness 215 to 240 untreated, and up to 365 heat treated; resists most corrosive solutions except those containing chlorides and other halogens; resists heat up to 2000 degrees Fahr.; tensile strength 90 to 105,000 pounds per square inch annealed and 40,000 to 150,000 pounds per square inch upon work hardening.

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INCONEL—International Nickel Co. Inc., New York. Composition is nickel 79.5, iron 6.5, copper .2, manganese .25, silicon .25, carbon .08 and chromium 13; resists heat up to 2000 degrees Fahr.; uses include high temperature applications, springs and machinery handling food products.

For further information see ad. on page 5D.

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INDUSTRIAL—Industrial Steels Inc., East Cambridge, Mass.

Stainless Steel, No. 35; chrome 13 to 14, carbon .30 to .40. No. 65; chrome 16 to 17, carbon .60 to .70. No. 100; chrome 17 to 18, carbon .9 to 1.

Stainless Iron, No. 12, chromium 11½ to 13. No. 18; chromium 16 to 20. No. 512; chromium 11½ to 13, .12 carbon, 0.3 to 0.4 sulphur, balance iron. No. 188; chromium 17 to 20, nickel 8 to 10. No. 5188; chromium 17 to 20, nickel 8 to 10. No. 188 SMO; chromium 17 to 20, nickel 8 to 10, molybdenum 2 to 4 per cent.

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INGACLAD—Ingersoll Steel & Disc Co., div. of Borg-Warner Corp., Chicago.

Stainless clad steel consisting of a 20 per cent layer of 18-8 chrome nickel, Type 306, also 18.8 columbium stabilized and 18-8 molybdenum bearing, stainless layer bonded to a layer of ordinary steel; uses include equipment for chemical, food, dairy, processing, brewery, packing house, bottling industries, etc.; suitable for applications requiring stainless steel protection on one surface.

1 - - 4 - - - - -

INLAND—Inland Steel Co., Chicago.

Copper bearing steel; used largely for sheets; copper minimum .20.

Silico-manganese spring steel.

Hi-Steel; high strength, low-alloy steel for applications where increased strength and corrosion resistance with decreased weight is desired.

Copper-nickel-phosphorus alloy steel.

1 2 - 4 - - - - -

INVAR—Produced by Acieries d'Imphy, France; marketed in United States and Canada by R. Y. Ferner Co., Boston. An alloy with a low coefficient of thermal expansion; nickel 36, iron 61 to 64, carbon 0 to 1, manganese .1 to 1,

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

silicon .1 to 1; for clock pendulums, instruments, struts for auto pistons.

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IRALITE—Mackintosh-Hemphill Co., Pittsburgh. Alloy iron; specified where sand cast iron could be used except for lack of strength.

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ISROD—Resisto-Loy Co., Grand Rapids, Mich.; carbon 3, silicon 1, manganese 2, chromium 2, molybdenum 5, and nickel 2; fair resistance to acids and alkalies; resists heat up to 800 degrees Fahr.; tensile strength 78,000 pounds per square inch; brinell hardness 545; for use where wear and shock resistant properties are desired.

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JALCASE—Jones & Laughlin Steel Corp., Pittsburgh.

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Low carbon open hearth steel which offers machinability practically equivalent to Bessemer screw stock plus the added advantage of rapid case carburizing properties; manufactured as S.A.E. X1314 and S.A.E. X1315 in .10 to .20 carbon grades.

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Open hearth steel which, in the higher carbon ranges, offers exceptional heat treating qualities combined with forging properties and good machinability; manufactured as S.A.E. X1330 (.25/.35 carbon), S.A.E. X1335 (.30/.40 carbon) and S.A.E. X1340 (.35/.45 carbon).

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JAL-TEN—Jones & Laughlin Steel Corp., Pittsburgh. High tensile steel; especially suitable for machine frame or bin construction; adaptable to hot or cold forming and is easily welded or punched for rivets or bolts; made in standard sections and shapes as specified.

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JELLIFF—C. O. Jelliff Mfg. Corp., Southport, Conn.

Alloy A; nickel 80, chromium 20, essentially iron free; non-magnetic; suitable for temperatures up to 2100 degrees Fahr.

Alloy C; nickel 64, chromium 15, iron 20; uses include electric heating elements for domestic appliances and rapid resistors.

Alloy D; nickel 20, chromium 15, iron 55; electrical resistance; low temperature heating elements.

Alloy 45; nickel 45, copper 55; temperature coefficient of resistivity is practically nil for use in electric measuring testing instruments.

Alloy 70; nickel and copper alloy intended principally for use in electrical heating devices up to 1100 degrees Fahr.

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JEWELL-ALLOY—Jewell Alloy & Malleable Co., Buffalo. Nickel 1.25, total carbon 1.75 to 1.80, silicon .90, chromium .50; castings for machine parts including cams, compressor valve seats and valve inserts.

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JOHNSON—Johnson Bronze Co., New Castle, Pa.

No. 27; copper 80, tin 10, lead 10; deoxidized with phosphorus; general purpose bearing bronze.

No. 19; copper 70, tin 11, lead 19; high wear rating and resistance to pounding; for mill bearings, gas and diesel engines, excavating and pulverizing machinery, etc.

No. 25 (plastic bronze); copper 75, tin 5, lead 19, nickel 1; for high speed with light to medium loads and generally free from shock; because it has good acid resistance it is particularly suitable for pump bearings and sleeves, and also for electric motor, conveyor and fan, and woodworking machinery bearings.

No. 29; copper 78, tin 7, lead 15; for use where spindle is of soft steel and speed is relatively high; acid resisting alloy.

No. 53; copper 88, tin 10, zinc 2; for severe service or heavy pressures; should be used where shaft is hardened steel and well lubricated.

No. 72; copper 83, tin 7, lead 7, zinc 3; best suited for moderate speeds and low loads.

No. 10 (babbitt alloy); tin 90, antimony 5, copper 5; for thin linings and also may be used in die castings.

No. 11; tin 87, antimony 7, copper 6; rather hard babbitt recommended as lining for connecting rods and shaft bearings subjected to heavy pressures.

No. 12; tin 90, antimony 7.5, copper 2.5; for high speeds and high temperatures.

For further information see ad. on page 29D.

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KANTHAL—C. O. Jelliff Mfg. Corp., Southport, Conn. An alloy of chromium, aluminum, cobalt and iron made in three grades A-1, A and D for temperatures of 2462 degrees Fahr., 2372, 2102 degrees Fahr. respectvely; made in all commercial sizes of round wire and rod, flat ribbon and strip.

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KINITE—H. Boker & Co. Inc., New York. High chromium steel castings resistant to abrasion and compression; for cutters, mandrils, and other machine parts.

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KLEENKUT—Heppenstall Co., Pittsburgh. Tool steel containing 2 carbon and 12 per cent chromium; for shear knives for cold shearing light material.

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KONAL—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Nickel 72, cobalt 17, titanium 2.2 and iron 6.25; internal combustion engine valves, molds and machine parts subject to stress at temperatures up to 650 degrees Cent.

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KONIK—Continental Steel Corp., Kokomo, Ind. S. A. E. 1010—S. A. E. 1020 plus 0.1-0.3 copper, 0.3-0.4 nickel, 0.07-0.30 chromium; case hardening steel in form of cold drawn wire used for parts subject both to strain and abrasion, such as chains

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KOVAR—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Low expansion to 400 degrees Cent.; approximately 28.2 nickel, 18 cobalt and 53.8 iron; for gas-tight metal-to-glass seals on radio tubes and similar applications.

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KROKOLOY — Detroit Alloy Steel Co., Detroit. Chromium 12 to 14, carbon 1.5 to 1.6, cobalt 1 to 3.5, molybdenum 1, air hardening tool steel castings.

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LIGHTWELD—Lincoln Electric Co., Cleveland; arc-welding electrode made for fabrication of chain and gear guards and other machine parts of light gage steel.

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LO CRO—Crucible Steel Co. of America, New York.

46; chromium 5.

46MO; chromium 5, molydenum .5.

46W; this and above grades are used widely where high strength at elevated temperatures up to 1200 degrees Fahr. is required.

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LOTUS BABBITT—Lumen Bearing Co., Buffalo. Lead base bearing babbitt.

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LUBRICO—Buckeye Brass & Mfg. Co., Cleveland. Copper 75, lead 20 and tin 5 per cent; for bearings, bushings and bars.

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LUKENS—Lukens Steel Co., Coatesville, Pa.

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Cromansil steel; (see listing under CROMANSIL)

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Carbon molybdenum steel; carbon .1 to .3, manganese .4 to .6, molybdenum .6 to 1; tensile strength 70,000 pounds per square inch; welding properties good; recommended for diesel engine housings, etc.

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Silico-manganese steel; carbon .3 max., manganese .6 to .9, silicon .18 min.; plate material of 70,000 pounds per square inch tensile strength; recommended for boiler work.

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Abrasive steel; a carbon-manganese plate steel of 75,000 pounds per square inch tensile strength; recommended particularly for gear rims.

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Nickel-chrome steel; plate material similar to S.A.E. 3340; 125,000 pounds per square inch tensile strength; recommended for liners and wearing plates.

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Manganese-vanadium steel; carbon .18 max., manganese 1.45 max., vanadium .08 to .12; plate material of 80,000 pounds per square inch tensile strength; recommended for welding structural parts.

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Nickel clad steel; pure nickel bonded to ordinary carbon steel; recommended for vessels, pots, mixers and digesters for resisting alkaline corrosion.

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Inconel clad steel; nickel-chromium alloy bonded to mild carbon steel; recommended for vessels, pots, mixers and digesters subject to alkaline and mild acid corrosion.

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Chrome-manganese steels.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

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Welding quality steels including "Weldrite;" low tensile strength.
For further information see ad. on page 3D.

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LUMEN ALLOY—Lumen Bearing Co., Buffalo.
(Note: "Lumen Alloy", together with each of the following numbers and grades, is a copyrighted term which should be used in specifying these materials. Thus, "Lumen Alloy No. 00A", etc.)

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Nos. 00A and 00C; high tin bronzes for high compression bearing applications.

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No. 1; zinc bronze for pressure castings including spur and bevel gears mating with steel.

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No. 2; zinc bronze for machine parts, bearings, etc.

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No. 3; zinc bronze for mine service and paper mill machinery and bearings.

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No. 4; phosphor bronze (leaded), for bearings.

No. 4A; high phosphorus bronze (leaded), for bearings on hard steel.

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No. 5; general service casting alloy; red brass; for low pressure valve bodies, etc.

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No. 7; phosphor bronze; uses include trolley wheels and castings to be nickel or chromium plated.

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No. 9; manganese bronze for machine parts requiring strength and electrical conductivity.

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No. 11-C; (sand cast) aluminum bronze; for miter, bevel gears and bearings subject to impact.

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No. 11-C; (heat treated) tensile strength 65,000 to 100,000 pounds per square inch; recommended where strength and corrosion and heat resistance are required.

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No. 14; zinc bronze; babbitt backing; for valve bodies, etc.

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No. 15; phosphor bronze; for worm wheels, bearings, etc.

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No. 15A; phosphor bronze (slightly leaded); for worm wheels, bearings, etc.

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No. 20; super-manganese bronze; for machine parts requiring extra strength.

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No. 27; (sand cast) aluminum bronze; for strength and corrosion resistance.

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No. 27; (heat treated) for extreme tensile strength and shock resistance.

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No. 48; nickel phosphor bronze; for bearings used with hardened steel, worm wheels, etc.

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No. 54; phosphor bronze (leaded) for bearings and worm wheels for intermediate service.

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Old Genuine Babbitt; high strength ingot babbitt for bearings.

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Cosmos Babbitt; ingot material for bearings.

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Bronze; a zinc base alloy for bearings.

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LXX—Ludlum Steel Co., Watervliet, N. Y. Carbon, .70, tungsten 18, chromium 4, vanadium 1; for lathe centers for severe service. Oil or air hardening.

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MACALLOY—Vanadium-Alloys Steel Co., Latrobe, Pa.

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No. 1; a chromium-nickel-molybdenum steel containing .35 carbon; tensile strength 200,000 pounds per square inch; recommended for pinions, spindles, cams, clutches, studs, etc.

No. 2; a chromium-nickel-molybdenum steel containing .6 carbon; tensile strength 305,000 pounds per square inch; recommended for spring collects, gears, arbors, races, and pinions.

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MACHEMPITE "Wearprooft" — Mackintosh-Hemphill Co., Pittsburgh. Alloy cast, forged or rolled steel; for gears, locomotive guides, track wheels, sprockets, conveyor parts, etc.

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MACHINEBRONZE—Lumen Bearing Co., Buffalo. Zinc bronze; cored and solid bars for bearings.

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MACKENITE METAL—Duncan Mackenzie's Sons Co. Inc., Trenton, N. J. For retorts, annealing pots, cylinders, and lead pan castings.

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MAL-ARC—P. R. Mallory & Co. Inc., Indianapolis. A hard-facing material marketed in the form of an electrode; for application to machine parts where abrasion is encountered.

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MALLIX — National Malleable & Steel Castings Co., Cleveland. Pearlitic malleable iron; tensile strength 75,000 pounds per square inch, elongation 5 per cent; for grate bars for sintering machines, elevator buckets, screen plates for pan mills and other castings subjected to heat, abrasion and shock.

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MALLORY—P. R. Mallory & Co. Inc., Indianapolis.

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3; an alloy consisting predominantly of copper; used extensively for spot, flash and seam welding cold-rolled steel, stainless steel, nickel alloys and monel metal, silicon bronze alloys, zinc, nickel, silver and other materials employed in numerous applications where a high strength, high conductivity material is required.

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53; copper base alloy furnished in rough and finished bars; tensile strength 90,000 to 100,000 pounds per square inch; used for springs, washers, marine hardware, flash welding dies, bearings and current and heat-carrying members in electrical and other machinery.

73; rough and finished bars and sheets containing 95 per cent copper; resists sea water; 160,000 to 200,000 pounds per square inch tensile strength; used for bearings and bushings, vibrator arms, springs, spring washers and electrodes for projection welding.

100; rough and finished bars containing 95 per cent copper; recommended for high leaded small gears, current-carrying bearings, springs and other details.

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MANGANIN—Wilbur B. Driver Co., Newark, N. J. Copper, nickel and manganese alloy; for shunts, wheatstone bridges, and precision instruments; possesses moderate resistivity, low temperature coefficient.

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MANGANO—Latrobe Electric Steel Co., Latrobe, Pa. Carbon .95, manganese 1.60, chromium .20; used where nonshrinking, oil quenching steel is required.

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MANGANWELD—Lincoln Electric Co., Cleveland. Arc welding electrode that produces deposit of austenitic manganese-nickel-molybdenum steel; suitable for hard facing austenitic manganese steel parts containing 11 to 14 per cent manganese, such as crusher parts, valves, turbine runners, pulverizer roll shafts, gathering and loading equipment.

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MAN-TEN—United States Steel Corp. and subsidiaries (See USS). Carbon .35 max., manganese 1.25 to 1.7, silicon .15 min., copper .20 min.; for use where high strength material is required.

For further information see ads. on pages 3D and 37D.

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MASSILLON—Massillon Steel Casting Co., Massillon, O. Alloy cast steel, heat treated; for domestic, industrial and locomotive stoker worms.

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MAURATH—Maurath Inc., Cleveland; alloy welding rods of many types; each type made especially for use with one of the leading varieties of stainless and heat-resisting steels and with coating of distinctive identifying color. Also uncoated electrodes and those of special analyses.

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MAX-EL—Crucible Steel Co. of America, New York.

2-B; carbon .40, manganese 1; used in "as rolled" condition for machine tool spindles, lead screws, racks, worms, piston rods, etc.

3½; for heat treated parts on machine tools, such as gears, arbors, spindles, etc.; also available in a case carburizing type.

1-B; carbon .20, with high manganese and low molybdenum; excellent machining and uniformity in carburizing response; used for automobile parts, machine tool parts, gauges, sprockets, etc.

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MAYARI—Bethlehem Steel Co. Inc., Bethlehem, Pa.

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Alloy iron; nickel-chromium-iron avail-

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

able in two grades: Standard Mayari, 0.5 to 3 silicon, and Silvery Marari, 7.5 to 12 silicon; used for high strength, heat-resistant, wear-resistant castings for cylinder blocks and liners, hydraulic machinery, refrigeration machinery, machine tools, marine engines and valves.

1 - - 4 - - - - -

A; a high tensile atmospheric corrosion-resistant, chromium-nickel-copper-silicon steel; particularly adapted to the manufacture of cars, barges, tanks, stills, structural parts, etc.

Steels; a series of nickel-chromium steels including carburizing and oil hardening grades for shafts, bolts, etc.; a special engine bolt grade is made for locomotive engine bolts and a stay-bolt grade for locomotive boilers.

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MAZLO Magnesium Alloys—American Magnesium Corp., Cleveland. Characteristics are light weight with mechanical strength and excellent machinability (2/3 that of aluminum); alkali resistant.

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No. AM 240; 90 magnesium, 10 aluminum; furnished in ingot form for sand casting and die casting; for parts of portable equipment and moving machinery where light weight and high strength is important.

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No. AM 265; 6 aluminum, 3 zinc, balance magnesium; furnished in ingots for sand casting; for parts of portable equipment and moving machinery.

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No. AM 230; 10 aluminum, 0.5 silicon, balance magnesium; furnished in ingots for die casting; for moving equipment and portable equipment.

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No. AM 57S; 6 aluminum, 1 zinc, balance magnesium; for use in the form of rods and tubes and for machinery where light weight is important.

No. AM 3S; 1.2 manganese, balance magnesium; furnished in ingots suitable for welding; for aircraft parts such as oil tanks, fuselage partitions and cowlings.

No. AM 58S; 8 aluminum, 1 zinc, balance magnesium; supplied in ingots for hot forgings and hot pressing; for highly stressed parts where lightness is important as in aircraft engines.

No. AM 65S; 3.5 aluminum, 5 tin, balance magnesium; for hot forged parts; highly stressed parts where light weight is important.

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MCGILL—McGill Mfg. Co., Valparaiso, Ind.

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Hard brass; copper-zinc-lead-tin-die casting alloy for parts having tolerance of plus or minus .005 or wider.

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Permanent mold castings; copper-aluminum-iron alloy suitable for pump liners, gears, corrosion resistant castings and parts requiring strength and toughness with minimum weight.

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MEEHANITE — Meehanite Metal Corp., Pittsburgh, and licensees. A sorbo-pearlitic iron containing silicon, manganese, phosphorus, sulphur and carbon, composition depending upon mixture and physical constitution as determined by service requirements; twelve grades, all of which can be heat treated, each having a separate and distinct combination of physical properties; available in cast form; for important machinery castings, gears and metalworking dies.

For further information see ads. on page 43D.

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METALINE—R. W. Rhoades Metaline Co. Inc., Long Island City, N. Y. Lubricating insert plugs of several diameters and lengths and in varied compositions for rendering bronze bearings and bushings oilless. Also bronze bearings complete in which Metaline plugs are inserted. Furnished in form of finished bearings.

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MICHIANA — Michiana Products Corp., Michigan City, Ind.

No. 48 Alloy; nickel 8, chromium 28.

No. 49 Alloy; nickel 8, chromium 18.

No. 100 Alloy; nickel 12, chromium 24.

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No. 55 Alloy; chromium 33.

No. 63 Alloy; nickel 15, chromium 28.

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MIDVALOY—Midvale Co., Nicetown, Pa. Applications to which the following grades are adaptable include machines in the chemical and refining industries, mining and metallurgical work, rolls for paper machinery, impellers for exhaust gases, mechanical stoker parts, hydraulic machinery parts, etc.

13-00 A; chromium 11.5 to 14, carbon over .35.

Stainless 7; castings only; chromium 20, carbon .25, copper 1.

13-00; chromium 15 max., carbon .12 or under.

17-00; chromium 15 to 18, carbon .12 or under.

21-00; chromium 18 to 23, carbon .12 or under.

26-02; chromium 27, nickel 2 max., carbon as required.

HR1; chromium 20, nickel 7, carbon .35, tungsten 4.

18-08; chromium 18, nickel 9, carbon .06 up.

25-10; chromium 24, nickel 11, carbon low.

25-10-B; chromium 23, nickel 11, carbon .55.

25-20; chromium 25, nickel 20, carbon low, molybdenum .2.

HY-X; chromium 8, nickel 22, carbon .50, copper 1.

ATV-3; chromium 14, nickel 27, carbon .48, tungsten 3.5.

30-30; chromium 30, nickel 28, carbon low.

17-35; chromium 19, nickel 35, carbon low.

ATV-1; chromium 11, nickel 36, carbon .35.

BTG; chromium 11.5, nickel 60, carbon .30, tungsten 2.5.

976; chromium 9.7, nickel 1.5, aluminum 2.3.

KA2, KA2S, KA2Mo, KNC-3; stainless steel for castings only.

18-08-Se; chromium 18, nickel 9, carbon .10, selenium .24.

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MILL BRASS MIX—E. A. Williams & Son Inc., Jersey City, N. J. Bearings, bushings and mill brasses.

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MISCO—Michigan Steel Casting Co., Detroit.

Grade A; nickel 35 to 37, carbon .50 to .70, chromium 15 to 17; high load carrying capacity up to 1950 degrees Fahr.; for furnace parts, carburizing boxes, retorts.

Grade B; chromium 24 to 26, nickel 12 to 14, carbon .20 to .30; for furnace parts in sulphurous atmospheres.

Grade B-1; chromium 24 to 26, nickel 12 to 14, carbon .40 to .60; for furnace parts in corrosive atmospheres.

Grade C; chromium 28 to 30; nickel 8 to 10, carbon .20 to .30; for valves, fittings and pump parts for sulphite service.

Grade C1; chromium 28 to 30, nickel 8 to 10, carbon .40 to .60; for high heat furnaces where sulphurous compounds are present.

Grade N; chromium 8 to 10, nickel 20 to 22, carbon .30 to .50; for valve and pump parts where alkali and sea water are encountered; heat resistant up to 1500 degrees Fahr.

Grade HN; nickel 60 to 65, chromium 15 to 18; carbon .60 to .80; for retorts, lead baths, etc.

Grade N-5; nickel 30, silicon 3 to 5, carbon .30 to .50; resistant to sulphuric acid; cast and rolled.

Grade 18-8; chromium 18 to 20, nickel 8 to 10, carbon to suit; for valve and pump parts.

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Metal; 35 per cent nickel, 15 per cent chromium; for machine parts subject to heat, wear and corrosion, pumps, valves, etc.

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MISCROME—Michigan Steel Casting Co., Detroit.

Grade 1; chrome 16 to 17, carbon .20 to .30; for pump and valve parts; nitric acid resistant and heat resistant up to 1400 degrees Fahr. as in hot oil-handling equipment.

Grade 2; chromium 18 to 23, carbon .20 to 30; possesses high tensile strength; for pump and valve parts; heat resistant up to 1600 degrees Fahr.

Grade 3; chromium 26 to 30, carbon .20 to .30; for severe nitric acid conditions; heat resistant up to 2200 degrees Fahr.; for ore roaster parts, furnace rails, etc.

Grade CR; 14 to 17 chromium, 2 to 3 carbon; heat and abrasion resistant (mild cases); heat resistant up to 1400 degrees Fahr.

Grade KR; chromium 26 to 30 per cent; carbon 2 to 3; abrasion resistant.

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MOLYBDENITE—Continental Roll & Steel Foundry Co., East Chicago, Ind. Special chrome molybdenum steel castings for mill pinions, guides and rolls.

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MO-LYB-DEN-UM — Climax Molybdenum Co., New York. An alloying element for use in steel and iron; imparts strength, toughness, ductility and resistance to abrasion; improves fatigue value, eliminates temper embrittlement, increases physical properties at elevated temperatures; molybdenum steel is easily welded and machined.

For further information see ad. on page 31D.

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MOLYBDIE—A. Finkl & Sons Co., Chicago.

Type C; carbon .40, manganese .60, chromium .85, nickel 1.50, molybdenum .30, phosphorus and sulphur .04 max.; for machine parts subject to extreme torsional strains, shock and vibration.

Type R; carbon .31, manganese .55, chromium .75, nickel 1.50, molybdenum .30, phosphorus and sulphur .04 max.; uses are similar to above material.

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MOLY-IRON—Weatherly Foundry & Mfg. Co., Weatherly, Pa. Molybdenum 1, chromium 1 per cent; resists heat up to 1000 degrees Fahr., tensile strength up to 55,000 pounds per square inch; brinell hardness 240; suitable for sand casting subject to heat and abrasion.

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MONEL—International Nickel Co. Inc., New York.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

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Type K; nickel 66, copper 29, iron 9, manganese .4, silicon .25, carbon .15, sulphur .05, and aluminum 2.75; for parts requiring strength and corrosion resistance, and those which must be nonmagnetic.

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Type R; nickel 67, copper 30, iron 1.7, manganese 1.1, silicon .05, carbon .1, sulphur .035; recommended for screw machine products and other parts requiring high speed machining.

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Type H; nickel 66, copper 29, iron 1.5, silicon 3, manganese 0.3, carbon 0.2; nonmagnetic material for sand casting requiring strength, hardness and corrosion resistance.

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Type S; nickel 65, copper 29, iron 2, silicon 4, manganese .3, carbon .2; a corrosion-resistant, nonmagnetic material which makes sand casting of medium hardness for resistance to galling.

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Metal composition of this alloy is nickel 67, copper 30, balance iron, manganese, silicon, carbon; general purpose alloy for use under corrosive conditions; also abrasion resistant.

For further information see ad. on page 5D.

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MORAINE—Moraine Products Co., Dayton, O. Rolled bronze split type bearings and bushings for automobiles and electric motors.

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MUELLER 600 BRONZE—Mueller Brass Co., Port Huron, Mich. Copper 60 per cent, zinc .35, other ingredients 5 per cent; for worm gears, connecting rods, seal rings for refrigerators, crankshafts for oil pumps, etc.

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MUNTZ METAL — American Brass Co., Waterbury, Conn., and Chase Brass & Copper Co., Waterbury, Conn. Copper 60, zinc 40; in sheet form.

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MUREX—Metal & Thermit Corp., New York. A series of welding electrodes designed for welding carbon-molybdenum steel, Cromansil steel, Cor-Ten, Mayari and similar steels.

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NA, NA-1, NA-2—National Alloy Steel Co., Blawnox, Pa. Varying percentages of nickel and chromium.

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NACO—National Malleable & Steel Castings Co., Cleveland. Specially processed cast steel; for service where heavy blows and constant friction require a material that combines great strength, toughness and resistance to wear.

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NATIONAL — National Smelting Works, Cleveland. Aluminum alloyed with various hardeners to meet special casting requirements.

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NIAGARA—Niagara Falls Smelting & Refining Corp., Buffalo. A line of alloying elements comprising some three hundred and fifty combinations applicable for deoxidizing and fluxing all types of metals intended for casting, and at the same time providing greater resistance to corrosion and higher pressure qualities such as are encountered in pumps and valves.

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NICHROME—Driver-Harris Co., Harrison, N. J.; acid and alkali and heat resistant alloy consisting of nickel 60, iron 25, and chromium 15; resists heat up to 2000 degrees Fahr. and is recommended for furnace parts, acid dipping baskets, and filter screen.

Type A; nickel 62, chromium 15; heating element material; also for electrical devices including rheostats, potentiometers, seamless tubing, etc.

Type B; as an additon to cast iron; sold in ratios of 5 and 2½ parts of nickel to 1 part of chromium.

Type V; nickel 80, chromium 20; heating element material; also in sheets for welded tubing, etc.

Cast Nichrome; for furnace parts, pyrometer protection tubes, conveyor castings and carburizing containers. Sheet Nichrome S; sheet; nickel 27, chromium 15, used for various applications.

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NICKEL—International Nickel Co. Inc., New York.

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Type A; nickel 99.4, copper .1, iron .15, manganese .2, silicon .05, carbon .1 and sulphur .005; a corrosion resistant material which resists heat.

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Type D; nickel 95.2, copper .05, iron .15, manganese 4.4, silicon .05, carbon .1, and sulphur .005; furnished in rods, tubing and wire; suitable for parts which must resist effects of products of combustion of gasoline and other fuels at high temperatures.

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Type Z; furnished in rods, wire and strips; suitable for use where exceptional high strength and corrosion resistance are demanded.

For further information see ad. on page 5D.

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NICRAL—Nicralumin Co., Jackson, Mich. Complete series of light aluminum alloys in various forms and tempers.

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NICUITE—A. W. Cadman Mfg. Co., Pittsburgh. Nickel bronze; tin 10, nickel 7, zinc 2.5, trace of phosphorus, balance copper; high compressive strength for slow or medium speed operation under extreme load pressures.

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NI-HARD—International Nickel Co. Inc., New York, and licensees. Nickel 4.5, chromium 1.5, total carbon 2.7 to 3.6; cast iron for chilled rolls, cement grinding balls, etc., where abrasion is encountered.

For further information see ad. on page 5D.

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NIKRO-M—Vanadium-Alloys Steel Co., Latrobe, Pa.; a chromium-nickel-molybdenum steel containing .55 carbon; tensile strength 290,000 pounds per square inch; recommended for collets, races, arbors, and gears.

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NILVAR—Driver-Harris Co., Harrison, N. J.; a 36 per cent nickel steel having the lowest coefficient of expansion up to 392 degrees Fahr. of an alloy; used for thermostatic controls in heating apparatus such as electric ovens, laboratory ovens, gas ovens, oil burners, and house heating apparatus.

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NI-RESIST—International Nickel Co. Inc., New York and licensees. Nickel 14, copper 6, chromium 2, total carbon 2, silicon 1.25 to 2, manganese 1 to 1.5; for castings handling corrosive waters and other solutions, or heats above the range of temperature where ordinary cast iron gives good service; resists corrosive vapors, gases and liquids; recommended instead of plain cast iron under such conditions.

For further information see ad. on page 5D.

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NIREX—Driver-Harris Co., Harrison, N. J.; alkali resisting material with tensile strength up to 95,000 pounds per square inch; supplied in finished rods or bars, wire, sheets and strip; also can be fabricated by sand casting; for use where corrosion and heat resistance, and spring properties will be useful.

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NI-TENSYLIRON — International Nickel Co. Inc., New York, and licensees. Nickel 1 to 4, total carbon 2.50 to 3.15, silicon 1.20 to 2.75, manganese .5 to .9; for machine tool castings, diesel engine housings, auto cylinder blocks, pistons, etc.

For further information see ad. on page 5D.

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NITRALLOY—Nitralloy Corp., New York, controls nitriding process and licenses under which alloy is produced. A chromium - molybdenum - aluminum steel capable of developing extreme hardness through nitriding; for cams and camshafts, gears, pump parts, splined shafts, cylinder liners, etc. Licensees include Bethlehem Steel Co., Crucible Steel Co. of America, Firth-Sterling Steel Co., Ludlum Steel Co., Vanadium-Alloys Steel Co., Republic Steel Corp., Lebanon Steel Foundry, Empire Steel Castings Co., Massillon Steel Castings Co., Milwaukee Steel Foundry Co., Warman Steel Castings Co., Simonds Saw & Steel Co.

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NITRICASTIRON — Nitricastiron Corp., New York; a cast iron of special compositions for surface hardening by nitriding process; for engine cylinder liners, pump and compressor liners, bushings, oil well equipment, airplane, automotive, tractor and machine tool parts. Licensees are Arcade Malleable Iron Co., Worcester, Mass., Forging and Casting Corp., Ferndale, Mich., Hunt-Spiller Mfg. Corp., South Boston, Mass., and Ludlum Steel Co., Watervliet, N. Y.

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NOGROTH—Q & C Co., New York. Castings of alloy iron, nickel and chrome; easily machinable.

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NONCORRODITE—Millbury Steel Foundry Co., Millbury, Mass. Chromium steel castings.

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NORDIC IRON—Reading Iron Co., Philadelphia. Special grade of bar iron for service where severe vibration is encountered; applications include hangers, brake rods, clevises, spring bands, etc.

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OILITE—Chrysler Corp., Amplex Division. Self-lubricating bronze bearings containing one-third oil by volume; used extensively in many industries such as automobiles, airplanes, farm implements, washing machines, textile

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

machinery, conveyors, air conditioners, railways, machine tools, etc.

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OLYMPIC BRONZE—Chase Brass & Copper Co., Waterbury, Conn.

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Type A; carbon .3, silicon .3, copper .96, zinc 1; brinell hardness 70 to 200; annealed at 1100 to 1200 degrees Fahr. if necessary to soften for additional cold working; resists corrosion due to saline, acid and alkaline solutions; tensile strength ranges from 55,000 to 150,000; for welding structural parts, bolts, nuts, pipe, bed plates and tie rods.

Type B; copper 97.5, silicon 1.5, and zinc 1; brinell hardness 50 to 100; annealed at 1100 to 1300 degrees Fahr. if necessary to soften for further cold working; resists corrosion due to saline, acid and alkaline solutions; tensile strength ranges from 45,000 to 80,000 pounds per square inch; for welding structural parts, bolts, nuts and pipe.

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Type C; copper 94.75, silicon 4.25, zinc 1; brinell hardness 85; resists corrosion due to saline, acid and alkaline solutions; tensile strength 40,000 to 45,000 pounds per square inch; for corrosion resistant castings.

Type D; copper 95.5, silicon 3, zinc 1; brinell hardness 90,000 to 200,000 pounds per square inch; a free machining material recommended for bolts, nuts, and screw machine parts.

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OXWELD—Linde Air Products Co., New York.

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No. 1; welding rod for steel giving welds of high tensile strength.

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No. 7; chrome iron welding rod giving welds of high tensile strength.

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No. 23; welding rod for aluminum giving corrosion resistance and high tensile strength.

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No. 25M; welding rod for bronze having brinell hardness of 96 and tensile strength of 55,000 pounds per square inch.

No. 28; a columbium bearing welding rod suitable for 18-8 stainless steel.

P

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PERMITE—Aluminum Industries Inc., Cincinnati, O.

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No. 1002; furnished in ingots for sand casting and gravity die casting; copper 10, iron 1.50 magnesium 40, balance aluminum; for pistons for automotive, pump and refrigeration service.

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No. 1008; furnished in ingots for sand casting and gravity die casting; copper 4, silicon 3, balance is aluminum; for machine parts to resist shock; heat treatment is to soak at critical and quench in water, and reheat at 350 degrees Fahr. to desired properties.

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No. 1019; furnished in ingots for sand casting; silicon 5, copper 1.25, magnesium 50, balance is aluminum; heat treatment, quenching in water; suitable for highly stressed parts including airplane engine parts.

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No. 2021; furnished in ingots for sand casting; magnesium 4, balance is aluminum; for parts subject to salt water corrosion.

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PHOS-COPPER—Westinghouse Electric & Mfg. Co., East Pittsburgh; rod and strip material containing 5 phosphorus and balance copper; giving high corrosion resistant and strong joints when brazing assemblies of copper and copper alloys to each other.

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PIONEER METAL — Pioneer Alloy Products Co. Inc., Cleveland. Approximately 65 nickel, chrome and molybdenum; castings; readily machinable.

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PMG METAL—Phelps Dodge Copper Products Corp., New York. High tensile silicon bronze having high strength and hardness, low coefficient of friction, resistance to impact, etc.; produced in form of rods, wire, tubing, strip, sheet, sand castings, die castings and centrifugal castings, uses include pump shafting, rods, bolts, nuts and rivets, valve parts, gears, bearings, and spindles.

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POMPTON—Ludlum Steel Co., Watervliet, N. Y. Carbon, .95-1.05; for arbors, bushings, collets and lathe centers. Water hardening.

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PRECISION—Precision Castings Co. Inc., Syracuse, N. Y.

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Type A-12; aluminum base alloy; silicon 12, balance aluminum; resists heat up to 1000 degrees Fahr., tensile strength 33,000 pounds per square inch; specific gravity 2.66; for general aluminum die casting uses.

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Type ZN-5; aluminum 4, copper 1, and balance zinc; tensile strength 42,000 pounds per square inch; compressive strength 85,000 pounds per square inch; specific gravity 6.71; brinell hardness 75; for general die casting uses—automotive, washing machines, electrical equipment, etc.

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Type ZN-6; aluminum 4, balance zinc; tensile strength, 36,000 pounds per square inch; compressive strength, 60,000 pounds per square inch; specific gravity 6.60; brinell hardness 65; for automotive and electrical equipment, washing machines, and miscellaneous mechanical parts.

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PROFERALL—Campbell, Wyant & Cannon Foundry Co., Muskegon Heights, Mich. Electric furnace high test cast iron, low carbon; chrome nickel molybdenum alloyed; for crankshafts and camshaft castings, high strength heat, resisting castings, hydraulic press and pressure castings, etc.

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PROMAL—Link-Belt Co., Indianapolis. Specially processed malleable iron; will withstand heavy loads without permanent distortion; where additional corrosion resisting properties are desired small percentages of copper can be added; can be hot-dip galvanized and will withstand repeated heating and cooling without growing brittle; uses include chain links, bearing caps, rocker arms, gears, sheaves, levers, and other machine parts subjected to severe service.

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PYRASTEEL—Chicago Steel Foundry Co., Chicago. Nickel varies from 8 per cent up, chrome from 8 to 26 per cent; available as castings for heat treating furnaces, screw conveyors, or any high temperature service up to 2200 degrees Fahr.

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PYROCAST — Pacific Foundry Co., San Francisco, Calif. A chrome nickel iron resistant to high temperature.

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PYRODIE—Heppenstall Co., Pittsburgh. Nickel chrome molybdenum steel, .6 carbon; for insert and hot die steel service.

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PYTHON—Ludlum Steel Co., Watervliet, N. Y. Carbon, .85, vanadium .25; for chuck jaws, clutch pins and other parts requiring unusual wear and shock resistance. Water hardening.

Q

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Q-ALLOY—General Alloys Co., Boston.

CN-1; chrome 22 to 26; nickel 10 to 12; resists corrosion due to attack from most all common acids and gases; brinell hardness 160 to 200 untreated; resists heat up to 2100 degrees Fahr.; has tensile strength of 75,000 to 95,000 pounds per square inch; used for machine parts where corrosion resistance is desired.

CN-2; chrome 17 to 21, nickel 7 to 9; resists general corrosion; brinell hardness 160 to 200 untreated, 160 to 200 heat-treated; resists heat up to 2100 degrees Fahr.; has tensile strength of 70,000 to 80,000 pounds per square inch; same use as above.

CN1-H; resists heat and corrosion; has tensile strength of 80,000 pounds per square inch; for castings subject to temperatures up to 2100 degrees Fahr.

CN1-MO; same data as for CN-1, except that it contains 1 to 4 per cent molybdenum.

CN2-MO; same data as for CN-2, except that it contains 1 to 4 per cent molybdenum.

Chrome C1; chrome 25 to 30, nickel 3 max.; resists corrosion due to mine water.

Chrome C2; resists corrosion due to nitric acid; used for machine parts where corrosion resistance is desired.

Chrome C3; resists heat up to 2000 degrees Fahr.; brinell hardness over 500 untreated; used for mill guides and any part requiring resistance to abrasion at high temperatures.

Grade A; resists heat up to 2200 degrees Fahr.; nickel 65 to 68, chrome 15 to 19; tensile strength approximately 70,000 to 80,000 pounds per square inch; annealing to remove casting stresses only; for machine parts requiring high temperatures up to 2200 degrees Fahr.

Grade B; approximately 60 nickel, 12 chromium; resists heat up to 2200 degrees Fahr.; tensile strength is approximately 65,000 to 75,000 pounds per square inch; for use where temperatures up to 2200 degrees Fahr. are required.

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RED ANCHOR—Anchor Drawn Steel Co., Latrobe, Pa. Carbon .95 to 1.10; commercial carbon drill rods; for pre-

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

cision shafts for motors, spindles, anvils and dental tools.

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RELLEUM BRASS—Mueller Brass Co., Port Huron, Mich. Copper 59, lead 2 and zinc 31; recommended particularly for parts of forged brass.

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RESILIA—Bethlehem Steel Co., Bethlehem, Pa. for highly stressed parts especially springs; equally serviceable for light springs in automobiles and machinery and for heavy springs for automotive and railroad equipment, heavy machinery, etc.

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RESISTO-LOY—Resisto-Loy Co., Grand Rapids, Mich. A hard-surfacing alloy for application by electric arc or acetylene torch to shovel teeth, third rail shoes, agricultural machinery parts, etc.

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REZISTAL—Crucible Steel Co. of America, New York.

Stainless irons; No. 12; 10 to 13.5 chromium. No. 17; 16 to 18 chromium. No. 20; 18 to 23 chromium. No. 27; 23 to 30 chromium. No. 162; 16 chromium, 2 nickel. No. 182; 18 chromium, 2 nickel. All have .12 max. carbon except No. 27 with carbon .25 max.

Stainless Steels; a group similar to the foregoing except having a higher carbon content; used principally for bearings, cutlery, etc., where hardness and resistance to corrosion are desired.

Stainless A; .3 carbon, 12 chromium. B; .60 carbon, 16 chromium. B-100; 1 carbon, 17 chromium.

KA-2 (chromium 18, nickel 8) and its modifications. No. 3; chromium 22, nickel 12. No. 4; chromium 20, nickel 25, silicon 2.50. No. 7; chromium 25, nickel 20. No. 2600; chromium 8, nickel 22, copper 1.25.

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RITA—Cannon-Stein Steel Corp., Syracuse, N. Y.

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No. 2; carbon .20, manganese 1.15, phosphorus and sulphur .05 max., nickel .50, chromium .30; brinell hardness untreated 174, heat treated 388; carburizing 1650 degrees Fahr. and for toughening at 1550 to 1575 degrees Fahr.; resists corrosion, due to chromium and nickel content; resists heat up to 500 to 600 degrees Fahr., and has tensile strength of 85,000 as rolled; for general machinery purposes where a free cutting uniform material of great strength and toughness is desired.

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No. 4; carbon .4, manganese .9, phosphorus and sulphur .08, chromium and nickel .5 max., brinell hardness untreated 223, heat-treated 461; recommended heat treatment, oil quenching, 1475 degrees Fahr.; resist corrosion due to chromium and nickel content, resists heat up to 900 degrees Fahr. and has tensile strength of 105,000 pounds as rolled. Recommended for spindles and shafts, toughness being reduced to render more readily machinable.

No. 5; carbon .50, manganese 1.20, phosphorus and sulphur .05 max., nickel .50 max., chromium .60; brinell hardness untreated 269, heat treated 627, recommended heat treatment for oil quenching is 1500 to 1525 degrees Fahr.; resists corrosion due to chromium and nickel content; resists heat up to 900 to 1000 degrees Fahr.; tensile strength of 130,000 pounds as rolled; for gears, jaws, studs, bolts, axles, etc.

No. 7; carbon .65, manganese .50, phosphorus .045 max., sulphur .05 max., chromium .60, nickel 1.25; brinell hardness untreated 179 to 223, heat treated 653; recommended heat treatment, water quenched, at 1425 to 1450 degrees Fahr.; oil quenched, at 1450 to 1475 degrees Fahr. Resists corrosion, due to nickel and chromium content; resists heat up to 700 to 800 degrees Fahr.; tensile strength 135,000 as rolled; for expander and dowel pins, vise and wrench jaws, pneumatic hammer pistons, etc.

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RIVERSIDE—Riverside Metal Co., Riverside, N. J.

Beryllium copper; heat treatable copper alloy; has high tensile strength and ductility; for electrical parts, springs, diaphragms, jet tips, valve sleeves and seats, etc.

Phosphor bronze; copper tin alloy to which phosphorus has been added; has high strength and ductility; used in electrical appliances and machinery as springs, bearings, diaphragms, textile ring travelers, etc.

Nickel silver; copper, nickel, zinc in varying proportions; for diaphragms, radio and telephone springs, screw machine products, etc.

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ROMAN BRONZE—Revere Copper & Brass Inc., New York. Copper 60, tin .75, zinc 39.25; for forging, flanging, upsetting; uses include piston rods, shafting, bearing applications, etc.

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RUSTLESS 17—Rustless Iron & Steel Corp., Baltimore.

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Type 430; carbon .12 max. and chromium 14 to 18; resists sulphur gases, nitric, and organic acids; for corrosion resisting rivets, screws, bolts and other parts.

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Type 430F; carbon .12 max., sulphur .15 min. and chromium 14 to 18; free cutting stainless steel which resists heat up to 1450 degrees Fahr.; has tensile strength up to 85,000 pounds per square inch.

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SABECO — Fredericksen Co., Saginaw, Mich.

No. 5 bearing bronze; copper 69 to 71, tin 4.5 to 5.5, lead 24 to 26, max., impurities .2; for light or medium load and water lubricated bearings.

No. 9; copper 69 to 71, tin 8.5 to 9.5, lead 20 to 22, max., impurities .2; for heavy loads such as average machine tool requirements.

No. 11; copper 69 to 71, tin 10.50 to 11.50, lead 18 to 20, max. impurities .2; for extra heavy unit pressures.

No. 11HG; copper 69 to 71, tin 10.5 to 11.5, lead 18 to 20, max. impurities .2; for worm wheels, clutch shifter shoes, forging machine slides, etc.

No. 16; copper 69 to 71, tin 15 to 17, lead 13 to 15, max. impurities .2.

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SAMSON—The Carpenter Steel Co., Reading, Pa.

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No. 5-317; chrome nickel steel; carbon .50, nickel 1.75, chromium 1; for gears, clutches and shafts.

No. 4-408; carbon .40, nickel 3, chromium .75; for clutches and shafts.

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No. 158; carbon .10, nickel 3.50, chromium 1.50; for case hardened high duty clash gears, shafts, clutch parts.

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No. 4 Samson steel; carbon .40, nickel 1.25, chromium .60; for side links of silent chains, shafts, axles, etc.

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No. 2 Samson; carbon .20, nickel 1.25, chromium .60; for gears, roller bearings, pneumatic tool parts, etc.

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No. 3-547; nickel steel; carbon .30, nickel 3.50; for heat treated shafts, etc.

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No. 2-547; case hardening nickel steel; carbon .20, nickel 3.50; for small parts requiring hard surface and tough core.

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No. 500; carbon .10, nickel 5; for turbine blades, case hardened gears, etc.

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Chrome Vanadium 5-720; carbon .50, chromium .90, vanadium .20; for leaf and coil springs, gears, shafts, etc.

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No. 3-427 chrome molybdenum steel; carbon .30, chromium 1, molybdenum .20; for aircraft and automotive parts.

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No. 436; carbon .15, nickel 1.75, molybdenum .25; for case hardened parts.

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SATCO—National Lead Co., New York. White metal bearing alloy; high melting point; nondeforming; suitable for die casting; primary application is bearing liners.

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SEMINOLE—Ludlum Steel Co., Watervliet, N. Y. Carbon, .45, chromium 1.30, tungsten 2, vanadium .25; for high creep strength bolts and studs for superheated steam; also machine parts having high wear and fatigue values. Withstands moderately elevated temperatures (up to 110 deg. Fahr.). Oil hardening.

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SEYMOUR—Seymour Mfg. Co., Seymour, Conn.

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Nickel silver, grade A; nickel base alloy which is corrosion resistant and has a tensile strength up to 100,000 pounds per square inch.

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Phosphor bronze, Grade A; brinell hardness 160 and tensile strength 105,000 pounds per square inch.

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Phosphor bronze, grade C; brinell hardness 175; tensile strength 112,000 pounds per square inch.

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SEYMOURITE—Seymour Mfg. Co., Seymour, Conn. Copper 64, nickel 18, zinc 18.

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SHAWINIGAN — Shawinigan Chemicals Ltd., Montreal, Que., Canada.

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Type KA2MO; carbon .15, chromium .20, nickel .9 and molybdenum 3; an acid resisting alloy with tensile strength up to 100,000 pounds per square inch; brinell hardness 185.

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Heat treating; carbon .3, chromium 28, and nickel 15; tensile strength 90,000 pounds per square inch; brinell hardness of 200; resists heat up to 2000 degrees Fahr.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

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Stainless and Heat Resisting Steel; chrome nickel steel; for application where corrosion and heat are encountered.

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SHIELD-ARC—Lincoln Electric Co., Cleveland.

Type 8.5; high tensile welding rod; recommended for fabrication of high tensile steels; brinell 190 to 250.

Type 100; brinell hardness 235 to 300.

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SHOCK PROOF—Lake City Malleable Co., Cleveland. Malleable iron of high tensile strength, high yield point and ability to withstand considerable shock loading and abuse, at the same time possessing good machining qualities; for cast parts to resist heavy strains, shocks and corrosion.
See ad. on page 48D.

1 2 - - - - - - - -

SICROMO STEEL—Timken Steel & Tube Div. The Timken Roller Bearing Co., Canton, O. Carbon, .15 max., manganese .50 max., silicon .50 to 1.00, chrome 2.25 to 2.75, molybdenum .40 to .60, suitable for cracking furnace tubes, high temperature heat exchangers, etc.

1 2 - 4 - - - - -

SILCROME—Ludlum Steel Co., Watervliet, N. Y.

12-EZ; Carbon .10, chromium 12 to 14; sulphur .20 to 30. Free machining type of straight chromium stainless steel with good ductility, abrasion resistance, non-seizing properties, suitable for all machine parts which have to be produced on automatic screw machines.

18-8 EZ; Carbon .20 max., chromium 17 to 19, nickel 7 to 9, selenium .20 to .30. Free machining type of chrome nickel stainless steels with increased corrosion resistance over the 12-EZ grade combined with good ductility, abrasion resistance and non-seizing properties. Suitable for all machine parts specified in the 18-8 chrome nickel types which have to be manufactured on automatic screw machines.

12; Carbon .12, chromium 12, good ductility, abrasion resistance and fair machining properties. It is recommended for all machine parts requiring moderate corrosion resistance and high physical properties which are developed by heat treatment. Principal applications, valve seats, stems, shafts, etc. and highly stressed machine parts.

12-2; Carbon .12, chromium 12, nickel 2. Similar to Silcrome 12 but possesses slightly higher ductility, corrosion resistance and resistance to repeated shocks.

L-12; Carbon .35, chromium 13, abrasion resistant with good ductility, must be heat treated for best corrosion resistance. Suitable for rollers, shafts, etc. in which a hardness of about 50C Rockwell is required.

M-17; Carbon .70, chromium 17, similar to L-12 but with increased corrosion resistance. Also can be hardened to a higher degree, namely about 55C Rockwell.

H-17; Carbon about 1; chromium 17 to 18; general purpose hardenable stainless steel which upon heat treatment develops maximum hardness (C.56-.58) together with high strength, corrosion and wear resistance. Suitable for needles, valve parts, shafts, roller bearings and all such parts in which strength, maximum hardness wear and corrosion resistance are essential.

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SILFRAM—Stoody Co., Whittier, Calif.; a hard-facing metal designed for application to parts subject to corrosion, abrasion and impact.

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SIL-TEN—United States Steel Corp. and subsidiaries (See USS). Carbon .40 max., manganese .60 min., silicon .20 min.; used in the design of machinery.

For further information see ads. on pages 3D and 37D.

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SIMPLEX—Crucible Steel Co. America, New York. Nickel 1.25, chromium .75; forging steel for machine parts requiring high strength and toughness; also available in case carburizing type.

1 2 3 4 5 - 7 - -

SIVYER—Sivyer Steel Castings Co., Milwaukee.

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"Sixty"; chromium 18; nickel 8, carbon .12 max.; an austenitic non-hardenable corrosion resistant cast steel; also non-magnetic.

1 2 - - - - - - - -

"Sixty-four"; chromium 27, nickel 10, carbon .25 max.; characterized by high strength and better corrosion resistance than "Sixty".

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"Sixty-six"; chromium 11.5 to 13.5, carbon .12 max.; hardenable cast steel of medium corrosion resistance. Five per cent chrome moly; a 5 per cent chromium, .5 molybdenum steel for oil refinery and power plant service.

- 2 - - - - - - - -

"Seventy"; chromium 15, nickel 35.

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Hi-carbon chrome moly; a 70 per cent chrome molybdenum air hardening cast steel for severe abrasion; for rolling mill rolls, wearing plates, etc.

6140; fine grained cast chrome vanadium steel for road machinery or excavator teeth, etc., combining abrasion resistance with good ductility.

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3140; chrome nickel general purpose steel; composition properly balanced for liquid quenching.

Miraculov; chrome nickel manganese molybdenum steel having high physical properties after air or oil quenching and tempering.

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Manganese nickel; manganese 1.2, nickel .75; suitable for differential water quenching.

Manganese vanadium; manganese 1.25, vanadium .10; cast steel with combination of strength and ductility.

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Dynamo; a low carbon, low manganese steel with low residual magnetism.

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SMITH DYNAMO STEEL—Smith Steel Foundry Co., Milwaukee; steel for sand castings containing carbon .10 and having a high degree of magnetic permeability; recommended for electro magnets, pole pieces and motor frames.

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STANDARD-ALLOY—Standard Alloy Co., Cleveland. Nickel 20 to 60, chromium 16 to 25 per cent; for heat and acid resisting castings.

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STANNUM BABBITT—Lumen Bearing Co., Buffalo. Tin base bearing babbitt.

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STERLING Stainless Steels—Firth-Sterling Steel Co., McKeesport, Pa.

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Type A (420); carbon .35, chromium 13.5; corrosion resistant; tensile strength of 240,000 pounds per square inch; for ball bearings and automotive parts where wear is effected.

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Type T (410); carbon .1, chromium 13; possesses maximum strength and elasticity without sacrifice of toughness; machinable and corrosion resistant; for pump rods, shafts, valve parts, gun barrels, pistons and machinery parts where strength is of greater importance than ease of machining.

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Type TX (403); modified Type T used for turbine blading.

1 - - 4 5 - - - -

Type FC (416); free cutting stainless steel wherein a slight sacrifice in physical properties and corrosion resistance is made to obtain easier machining; for machine parts including screws, bolts, nuts, pump shafts, valves and spindles.

1 - - 4 5 - - - -

Nirosta, Types KA2, KA2-FC, KA2S and 19-9; of the 18-8 chrome-nickel group containing approximately 18 per cent chromium and 8 per cent nickel with various modifications or additions to give special physical properties, machinability or resistance to certain corrosive action; the free cutting type can be easily machined, and cold work-hardened wire and strip have great strength and resiliency.

Type A(420); good physical properties in heat treated state; maximum resistance to corrosion secured by hardening and through grinding; for wear resisting parts.

Type T(410-425); carbon .10, chromium 13; brinell hardness 165 untreated and 400 heat treated; high tensile strength type; for valves, trim, pump rods, pistons, etc.

Type TX(403); developed for turbine blading.

Type M(430); soft ductile steel that does not work-harden readily; requires no heat treatment to secure corrosion resistance.

Type MG(442); used where strength and toughness are secondary to workability and high temperature resistance.

Type KA2(302); an 18-8 steel; used particularly in oil and chemical industries; in hard wire this material is especially suitable for springs.

Type FC(303); free machining 18-8 steel

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STOODITE—Stoody Co., Whittier, Calif. A hard-facing metal used chiefly as overlay on earth working equipment.

1 2 3 - - - - - - -

STOODITE (Numbered)—Stoody Co., Whittier, Calif.; include Stoodite "45", "54" and "63", which range in physical properties from extreme hardness to extreme toughness. Rockwell "C" hardness indicated by numbers; designed for applications, involving heat, corrosion, impact or abrasion.

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STOODY (Self-Hardening)—Stoody Co., Whittier, Calif.; a hard-facing metal used chiefly as an overlay on earth working equipment.

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SUMET—Sumet Corp., Buffalo.

SM-4; lead 28 per cent; for light and medium duty bearings in high speed service.

SM-8; lead 26; for moderately severe service.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

SM-10; lead 24; for bearings subject to shock and impact.
SM-12; lead 22; for slow speed underheavy load and impact.
SM-14; lead 14; for severe service subjected to heavy shock.
SM-16; lead 20; for heavy duty slow speed service.
SM-18; lead 17½; for extremely severe service; uses include roll neck bearings; also suitable for gear blanks.

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SUPERLOY — Washington Iron Works, Seattle, Wash.

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K2Mo; corrosion resistant stainless steel; castings.

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Manganese steel; abrasion resistant steel castings.
No. 10; high carbon chrome nickel molybdenum steel; abrasion resistant steel castings.

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No. 4; chrome nickel molybdenum steel; high tensile strength steel castings.

- 2 - 4 - - - - -

SUPERTEMP—Bethlehem Steel Co., Bethlehem, Pa. A patented alloy steel having high tensile strength at high temperatures; suitable for bolts and studs for reaction chambers, cracking stills, superheaters, etc.

SWEETALOY—(See Cooper Alloy).

T

1 - - 4 5 - - - -

TAMCO—Titanium Alloy Mfg. Co., Niagara Falls, N. Y. Alloys including original high and medium carbon ferro carbon-titanium, foundry ferro titanium, and several varieties of low carbon ferro titanium for rolled, cast and forged steels, stainless and alloy steels, and gray cast iron. For the nonferrous field, alloys include TAM Webbite (alumino-titanium) for aluminum castings, cupro-titanium for copper, nickel-titanium, molybdenum-titanium, and special alloys for special purposes, in addition to metallic titanium and metallic zirconium.

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TANTALUM BRONZE—Ruselite Corp., Milwaukee; aluminum 10, molybdenum .6, tantalum .20 and balance copper; tensile strength 72,000 to 120,000 pounds per square inch; recommended where extremely high tensile bronze is required.

1 - 3 - - - - - -

TANTIRON—Bethlehem Foundry & Machine Co., Bethlehem, Pa. Iron 84.9, silicon 13.5, carbon .8 to 1, manganese .4, phosphorus .18, sulphur .05; can be machined only by grinding; castings for vessels, liners, inserts, chutes, feed pipes, etc.

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TEMP ALLOY—Continental Roll & Steel Foundry Co., East Chicago, Ind. Chrome alloy heat resisting cast iron used for furnaces and other designs subject to high temperatures and abrasion.

1 - - 4 - - - 8 -

TEMPALOY—American Brass Co., Waterbury, Conn. Copper aluminum and nickel alloys which yield to heat treatment; uses include motor boat shafting, piston rods, etc.

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TETON — Ludlum Steel Co., Watervliet, N. Y. Carbon 1, chromium 1.40; for balls and ball races, bushings, cams, etc. Usually hardened in oil.

1 2 - - - - - - -

THERMALLOY — Electro-Alloys Co., Elyria, O.
Grade A; 64 to 66 nickel, 17 to 20 chromium.
Grade 72; 58 to 62 nickel, 12 to 15 chromium.
Grade B; 38 to 42 nickel, 16 to 19 chromium; for rollers, chain, skid rails and disks.
Grade 50; 33 to 37 nickel, 14 to 16 chromium.
Grade C; under 2 nickel, 25 to 30 chromium; used in chemical industry for rabble arms, etc.
Grade D; 2 to 5 nickel, 25 to 30 chromium.
Grade E; 8 to 12 nickel, 24 to 28 chromium.

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THERMOMETAL—H. A. Wilson Co., Newark, N. J.; a thermostatic bimetal furnished in strips and some parts for use in temperature indication and control and electrical indication and control apparatus.

1 2 - 4 - - - - -

3½ PER CENT NICKEL STEEL—Cannon-Stein Steel Corp., Syracuse, N. Y.
S.A.E. 2315; carbon .15, manganese .45, phosphorus .04, sulphur .05, silicon .30, nickel .35; brinell hardness untreated 174; recommended heat treatment carburized at 1650 degrees Fahr. heat treated, at 1450 to 1500 degrees Fahr. oil quenched. Resists corrosion due to nickel content; resists heat up to 800 to 1000 degrees Fahr.; tensile strength 85,000 as rolled; for king pins, rock drill parts, air hammer parts, universal joints, bolts, shafts, studs, etc.
S.A.E. 2320; carbon .20, manganese .50, phosphorus .04, sulphur .05, silicon .03 max., nickel 3.50; brinell hardness untreated 174; recommended heat treatment carburized at 1650 degrees Fahr., heat treated at 1450 to 1500 degrees Fahr.; resists corrosion due to nickel content; resists heat up to 800 to 1000 degrees Fahr.; tensile strength 90,000 pounds as rolled; for uses same as S.A.E. 2315.

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TIGERLOY—Massillon Steel Casting Co., Massillon, O. Nickel-molybdenum; for shovel castings, gears, crane track wheels, castings for impact resistance, etc.

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TIMANG—Taylor-Wharton Iron & Steel Co., High Bridge, N. J. Nickel manganese steel; can be rolled, drawn, forged or shaped; for journal box liners, pedestal gib liners, conveyor flights, welding rod, etc.

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TISCO—Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

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Stainless steel castings of all compositions, including chrome-molybdenum, nickel - chrome - molybdenum, 18 - 8 chrome-nickel, and high chromium.

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Manganese steel castings for shock and abrasion resistance.

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TOBIN BRONZE — American Brass Co., Waterbury, Conn. Copper 60, zinc 39.25, tin .75; uses include piston rods, boat shafting, condenser head plates, forgings, seamless tubes, etc.

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TOLEDO ALLOY—Industrial Steel Casting Co., Div. of Unitcast Corp., Toledo, O.

- - 3 - - - - 8 -

No. 3; carburizing steel, heat treated to give good machinability and uniform grain; excellent results obtained with short cycle carburizing treatment.
No. 4; abrasion resistant silicon-molybdenum steel with good hardening properties; used for mining tools, wear plates, crusher plates and pinions.

- - 3 - - - - - -

No. 6; air hardening die steel of uniform machining qualities; long life under severe wear.

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No. 7; triple heat treated carbon vanadium steel for many applications in the railroad and locomotive industry where extensive and repeated stress is encountered.

- - 3 4 5 - - 8 -

No. 8; pearlitic manganese steel with analysis adjusted to give high tensile strength and ductility; used in automotive and aircraft equipment and other machines. Adaptable to flame hardening for selective treatment and oil hardening for complete quenching treatment.
For further information see ad. on page 39D.

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TONCAN IRON—Republic Steel Corp., Cleveland. An open hearth iron alloyed with .40 min. copper and .05 min. molybdenum; resists corrosion due to atmosphere, water, oils and process materials; tensile strength 50,000 min.; compressive strength 40,000; brinell hardness 110; for housing, piping, tubing, etc.

1 2 3 - - - - - -

TOOLWELD—Lincoln Electric Co., Cleveland. Coated arc welding electrode providing a deposit with hardness of 683-71 Brinell; hardness retained up to 1000 degrees Fahr.; deposit can be heat treated same as high speed steel; for building hard, tough cutting edges on cold rolled steel and for other applications requiring superhardness.

1 2 - - - - 7 - -

TOPHET—Wilbur B. Driver Co., Newark, N. J.
Type A; approximately 80 per cent nickel and 20 chromium; resists heat up to 2100 degrees Fahr.; supplied in wire and strip form for electrical heating applications.
Type C; nickel, chromium and iron; resists heat up to 1900 degrees Fahr.; supplied in wire and strip form; for electrical resistance and heating applications; heat resistant.

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TRODALOY No. 1—General Electric Co., Schenectady, N. Y. Resistance welding electrode alloy containing 2.6 per cent cobalt, .4 beryllium, 97 copper, has 55 per cent conductivity of copper; 45,000 pounds per square inch proportional limit; 220 brinell hardness; used for switch blades, cams, spring fingers, etc. Licensees are: Riverside Metal Co., P. R. Mallory Co., Ampco Metal Co., and Electroloy Co.

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TRUALOY—True Alloys Inc., Detroit.

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Copper; has high conductivity; castings for welding machines and conduction of current.

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Bearing bronze; low friction and wear, with high compressive strength; resistant to pounding and easy to machine.

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Aluminum; castings possessing strength, hardness and lightness.

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Aluminum bronze; for sand castings having corrosion resistance and tensile strength of 65,000 pounds per square inch; recommended for parts subject to strain and wear.

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TUF-STUF—Mueller Brass Co., Port Huron, Mich. Copper 87 per cent, iron 3, aluminum 10; for application where

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

high tensile strength, resistance to abrasion and to sulphuric acid are required.

U

1 2 3 - - 6 - 8 -

UNILOY — Universal-Cyclops Steel Co., Titusville, Pa.

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1435 (stainless grade A), (Type No. 420); chrome 13.50, nickel .50 max., carbon over .12.

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1860 (stainless grade B), (Type No. 440); chromium 17, nickel .50 max., carbon over .12.

Special (18-8), (Type No. 302); chrome 18, nickel 8, carbon .20 max.; heat resisting up to 1600 degrees Fahr.

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24-11, (Type No. 309); chrome 24, nickel 12; heat resisting up to 1800 degrees Fahr.

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1409, (Type No. 410); stainless iron; chromium 13, carbon .12 max.

1809, (Type No. 430); high chrome stainless iron; chromium 18, carbon .12 max.

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2825, (Type No. 446); high chrome iron; chromium 28, carbon .35 max.; heat resisting to 2000 degrees Fahr.

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UNION—Union Drawn Steel Co., Massillon, O.

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Freecut; carbon .13 max., manganese .6 to .9, phosphorus .08 to .11, sulphur .1 to .2; a bessemer type steel recommended for high production screw machine parts requiring good finish.

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Supercut; a bessemer type bar steel; carbon .13 max., manganese .60 to .90, phosphorus .08 to .11, and sulphur .200 to .325; similar to Freecut.

Hymo; carbon .15 to .25, manganese 1 to 1.30, phosphorus .04 and sulphur .10 to .18; recommended for spark plug shells, hose brake couplings, piston pins, king pins and carburized gears.

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Special Carburizing; carbon 13 to .18, manganese .60 to .90; phosphorus .04 max., sulphur .05 max., and silicon .20; recommended for piston pins and carburized gears.

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UNIVAN—Union Steel Casting Co., Pittsburgh. Nickel vanadium alloy; for locomotive frames, crossheads, coupling boxes, driving wheel centers, etc.

1 2 3 4 - - 7 - -

USS—United States Steel Corp. subsidiaries, including Carnegie-Illinois Steel Corp., Columbia Steel Co., National Tube Co., Tennessee Coal, Iron & Railroad Co.

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Type 302, USS 18-8; carbon over .08 to .2, chromium 17.5 to 19 and nickel 8 to 9; atmospheric, acid and heat resistant; has ductility facilitating fabrication.

Type 304, USS 18-8-S; carbon .08 max., chromium 17.5 to 19, and nickel 8 to 9; similar to type 302; used where excellent corrosion resistance is desired after fabrication by welding.

Type 321, USS 18-8-Ti; carbon .1 max., chromium 17 to 20, nickel 7 to 10; titanium minimum 4 x carbon; and alloy of the 18-8 group in which the addition of titanium prevents susceptibility to intergranular corrosion.

Type 316, USS 18-8-s-Mo; carbon .1 max., chromium 16 to 19, nickel 14 max. and molybdenum 2 to 4; an alloy of the 18-8 group, addition of molybdenum increases resistance to corrosion in specific cases.

Type 309, USS 25-12; carbon .2 max., chromium 22 to 26 and nickel 12 to 14; good high temperature strength and toughness combined with resistance to scaling up to 2100 degrees Fahr.

Type 303, USS 18-8 FM; carbon .2 max., chromium 17 to 19, nickel 7 to 9.5, sulphur or selenium .07 min. or molybdenum .6 max.; an 18-8 alloy; addition of sulphur, selenium or molybdenum increases the machinability, generally not to be used where welding is required.

Type 347, USS 18-8 Cb; carbon .1 max., chromium 17 to 20 nickel 8 to 12 and columbium 10 x carbon; 18-8 alloy, addition of columbium prevents susceptibility to intergranular corrosion.

Type 501, USS 5; carbon over .1 and chromium 4 to 6.

Type 502, USS 5-S; carbon .1 max. and chromium 4 to 6; .5 molybdenum is added to increase creep strength and avoid temper brittleness; columbium is added to eliminate air-hardening and increase oxidation resistance slightly.

Type 410, USS 12; carbon .12 max., chromium 10 to 13.5 corrosion and oxidation resistant, responds to heat treatment and can be modified by the addition of columbium, aluminum and molybdenum for specific applications.

Type 416, USS 12 FM; carbon .12 max., chromium 12 to 14 and sulphur or selenium .07 min. or molybdenum .6 max.; similar to Type 410 except addition of sulphur, selenium or molybdenum increases the machinability; not to be used where welding is required.

Type 430, USS 17; carbon .12 max. and chromium 14 to 18; resistant to atmospheric and milder chemical corrosives; finds wide usage in nitric acid equipment.

Type 446, USS 27; carbon .35 max. and chromium 23 to 30; resists heat up to 2150 degrees Fahr.; does not have high temperature strength and toughness of 25-12.

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Chrome-moly pipe steel; carbon 10 to 20, manganese .60 max., silicon .45 to .75, chromium 1.5 to 2, molybdenum .60 to .80.

Flange-bolt; carbon .35 to .45, manganese .40 to .60, silicon .45 to .75, chromium 1.5 to 2, molybdenum .60 to .80.

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Castings: Hadfield manganese steel No. 6; carbon 1 to 1.4, manganese 10 to 14. Chrome manganese No. 19; carbon 1 to 1.4, manganese 10 to 14, chromium 1. Chrome nickel moly No. 3; carbon .75 to .85, manganese .9 to 1, chromium 1.4 to 1.6, nickel .50 to .75, molybdenum .3 to .4, and others.

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Cor-Ten (See listing under C)
Man-Ten (See listing under M)
Sil-Ten (See listing under S)
Manganese chromium, Cromansil (See listing under C), S.A.E. and related heat treating steels.

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American Transformer 60, 66, 72 (Figures as hundredths indicate watt loss).

American Dynamo, Motor, Armature, etc.

For further information see ads. on pages 3D and 37D.

V

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VANADIUM—Vanadium-Alloys Steel Co., Latrobe, Pa.; types D, G, H, and K; tensile strength up to 250,000 pounds per square inch; recommended for collets, races, arbors, shafts, pinions, etc.

VANCORAM—Vanadium Corp. of America, New York. Ferro-alloys of vanadium, silicon, chromium and titanium; also special alloys and metals.

W

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WAUKESHA—Waukesha Foundry Co., North Chicago, Ill.; a copper-base alloy with high nickel content which resists mild acids and heat up to 750 degrees Fahr.; tensile strength 650,000 pounds per square inch; for sand cast parts of food handling and dairy machinery, carbonated beverage equipment, brewery equipment and meat packing equipment.

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WEARWELD—Lincoln Electric Co., Cleveland; brinell hardness of 488 to 548; suitable for hard-facing wearing surfaces subject to shocks and abrasion.

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WILCO—H. A. Wilson Co., Newark, N. J.; a silver and platinum inlay and overlay on base metals; in the form of sheet and wire for use in contacts for projection welding, etc.

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WORTHITE—Worthington Pump & Machinery Corp., Harrison, N. J.; iron .48, nickel 24, chromium 20, molybdenum 3, carbon .07 max., and other elements 5; a sand casting alloy; furnished in rods and bars; resists sulphuric, nitric, phospheric, acetic, weak muriatic acids and all caustics and alkalies; also resists heat up to 1900 degrees Fahr.; tensile strength 67,000 to 75,000 pounds per square inch; brinell hardness 125 to 150 (cast); for valves, bolts, pump casings and impellers, propellers, agitators, shafts, piston rods, fittings, etc., subject to heat and corrosion.

X, Y, Z

- 2 - 4 - - - - -

X-7—General Alloys Co., Boston; chrome 23 to 28, nickel 10 to 13; tensile strength 80,000 pounds; recommended for castings subject to temperatures up to 2000 degrees Fahr.

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X-ITE—General Alloys Co., Boston. Nickel 37 to 40, chromium 17 to 21; for furnace parts not subjected to alternate heating and cooling cycles; standard material for commercial heat treating furnace parts.

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YOLOY—Youngstown Sheet & Tube Co., Youngstown, O. Special service alloy steel of increased tensile strength and high ductility combined with corrosion resistance.

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ZAMAK—New Jersey Zinc Co., New York. Zinc alloys for die cast machine parts.

No. 2; aluminum 4.1, copper 2.7, magnesium .03, remainder Horse Head special zinc.

No. 3; aluminum 4.1, magnesium .04, remainder Horse Head special zinc.

No. 5; aluminum 4.1, copper 1, magnesium .03, remainder Horse Head special zinc.

For further information see ad. on page 27D.

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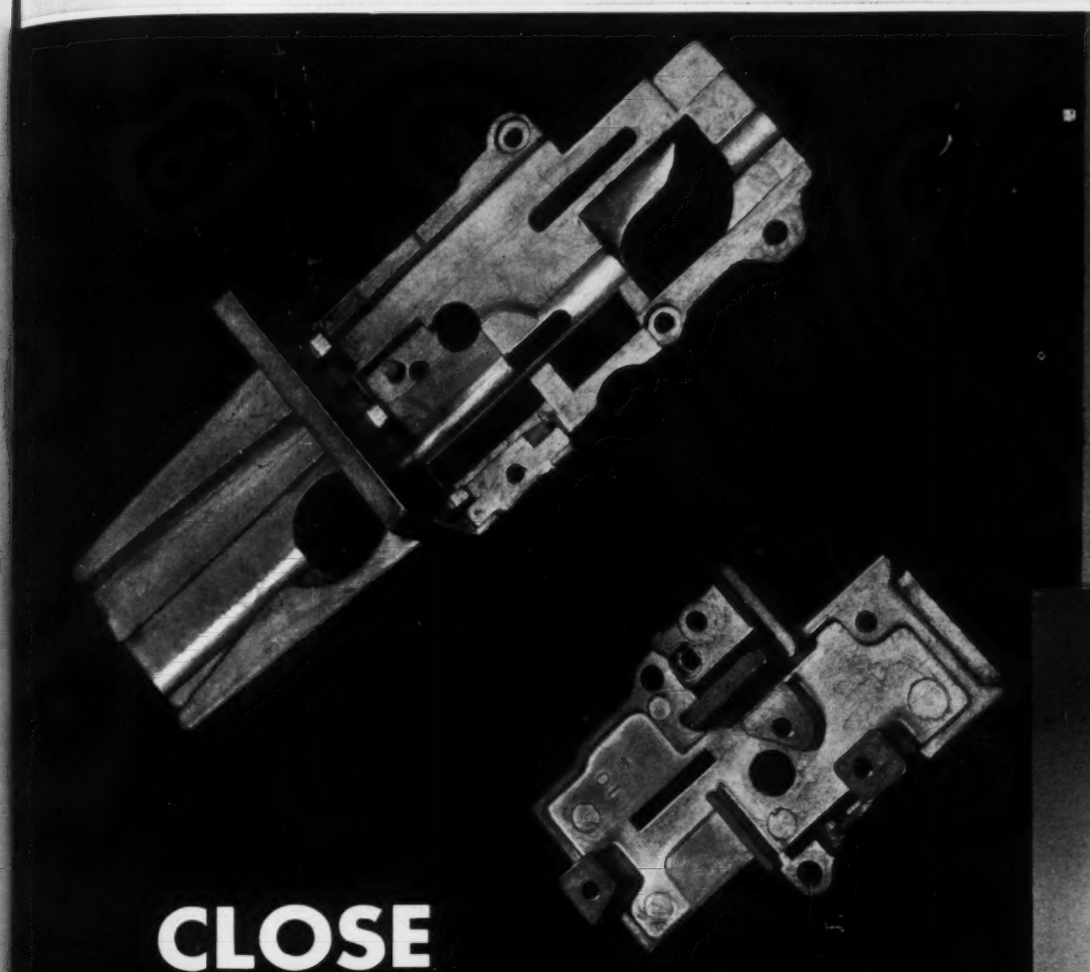
Z-METAL—Produced under metallurgical control of the Castings Corp., Buffalo, by foundries equipped with special heat treatment equipment; alloyed white iron having high physical characteristics; high ultimate strength and yield point, adequate ductility.

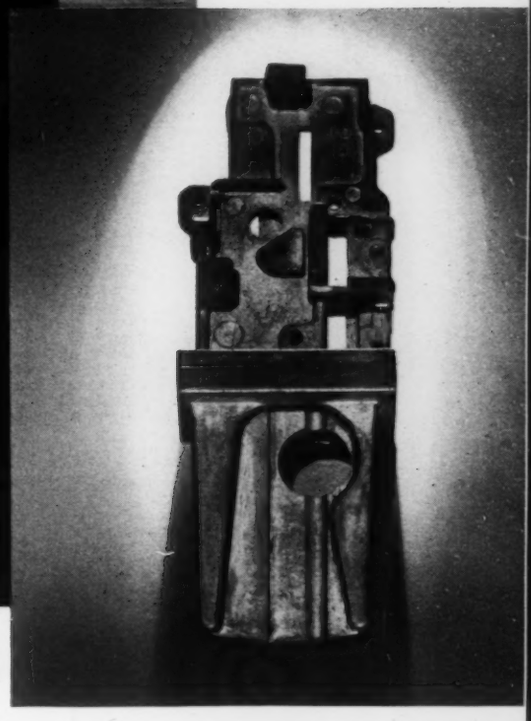
- 2 - - - - - - -

ZORITE—Michiana Products Corp., Michigan City, Ind. Nickel 37, chromium 15 per cent.

1—Corrosion resistant; 2—Heat resistant; 3—Abrasion resistant; 4—High tensile strength; 5—High ductility; 6—Bearing application; 7—Electrical uses; 8—Heat treating; 9—Low specific gravity

ZINC ALLOY DIE CASTINGS





CLOSE TOLERANCES

—Even In Mating Parts

An advantage of the die casting process that has not received its due is that of the ability to hold to close dimensional limits.

The two parts shown here are the coin slide frame and cover used on a well-known coin operated phonograph. A study of the following features will reveal why these parts were die cast of ZINC Alloy.

(1) **TOLERANCES**—the parts have been held within ±.002, even for dimensions between the two parts when assembled.

(2) **DIMENSIONAL STABILITY**—the proper selection of alloy has insured against dimensional change—an absolute essential in a delicate coin accepting mechanism.

(3) **STRENGTH**—because of the abuse to which these parts are subjected, the high impact strength of modern ZINC Alloys affords the necessary protection.

(4) **ECONOMY**—the two castings are shown *as cast*. No machining will be needed before assembling them into a smoothly working unit. The extreme complexity of the design is carried out with only two parts—an impossibility with other methods of fabrication.

Any commercial die caster will be glad to discuss ZINC Alloy Die Castings and their possible application in *your* products—or write to this Company.

THE NEW JERSEY ZINC COMPANY

60 Front Street New York

These castings and many others equally interesting may be found in our booth — F32 — at the National Metal Exposition.

The Research was done, the Alloys were developed, and most Die Castings are specified with

HORSE HEAD SPECIAL (99.99+% UNIFORM QUALITY) ZINC

Plastics and other Nonmetallics Listed by Tradenames

(For listing by producing companies, and complete street addresses, see page 44D)

A

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ACE—American Hard Rubber Co., New York. Hard rubber materials; furnished in sheet form or rods and tubes; machined, molded and stamped into part. Besides resistance to corrosion, low moisture absorption and high polish, material has tensile strength (4000-9000 lbs. per sq. in.), heat resistance (150-190 degrees Fahr.), dielectric strength (250-290 volts per mil) and nonflammability. Uses include handles, caster wheels and special molded parts.

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ACRYLOID—Resinous Products & Chemical Co., Philadelphia. Polymerized, acid ester; furnished in powder or liquid form; for molding into parts. Principal properties are corrosion resistance, high polish and low moisture absorption. Material is flexible, white and non-yellowing.

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AERTITE — Johns-Manville, New York. Rubbery, asphaltic-asbestos material; furnished in soft plastic form. Principal properties are resistance to corrosion, heat resistance and nonflammability. Used on mechanical equipment to prevent air infiltration.

1 - - 4 5 - - - - -

AETNA — Aetna Rubber Co., Cleveland. Hard rubber material; furnished in rods and sheets. Principal properties are corrosion resistance, comparatively high tensile strength and dielectric strength. Material is unusually low in specific gravity. Used for storage battery containers, vent caps, covers and nuts.

1 - 3 4 - - - - - -

AIRVULC — Self-Vulcanizing Rubber Co. Inc., Chicago. Gum rubber base material; furnished in liquid form. Besides abrasion resistance, corrosion resistance and comparatively high tensile strength (2000 lbs. per sq. in.), material has resistance to shock, high polish, flexibility, heat resistance (212 degrees Fahr.), low moisture absorption and availability in colors. Used in machines to resist corrosion or abrasion, as a sound deadner and for insulation and waterproofing.

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AJAX—Vulcanized Rubber Co., New York. Hard rubber, thermoplastic material; furnished in sheet form or rods and tubes; molded, machined, stamped, and extruded into parts. Three principal properties are dielectric strength (6500 volts per mil), corrosion resistance and availability in colors. Others include abrasion resistance, high polish, flexibility, tensile strength (6500-9000 lbs. per sq. in.) and resistance to shock. Soluble only in carbon disulphide. Used for handles, bushings, strips, rod and tube bases.

- - - - - - 6 7 - 9 -

AMEROID—American Plastics Corp., New York. Casein base, thermoplastic material; furnished in sheet or rod form, for machining into part. Besides nonflammability, high polish and availability in colors, material has resistance to corrosion, tensile strength (7600 lbs. per sq. in.), heat resistance (150 degrees Fahr.), translucence and dielectric strength (290 volts per mil.). Uses include small knobs, bushings, washers and similar parts.

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ARCOLITE—Consolidated Molded Products Corp., Scranton, Pa. Phenol-formaldehyde base, thermosetting material; furnished in powder, for molding into parts. May be molded around or over metal or wood cores in parts requiring great strength and rigidity. Besides dielectric strength (325 volts per mil), heat resistance (300-400 degrees Fohr.) and tensile strength (7000-12,000 lbs. per sq. in.), material has high polish, nonflammability, availability in colors and low moisture absorption. Used for parts and decorative items on machines.

B

1 2 3 - 5 6 7 8 9 10

BAKELITE—Bakelite Corp., New York.

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Cellulose filled — Phenolic base; thermosetting material; furnished in powder form; molded into part. Besides corrosion resistance, high dielectric strength (300-500 volts per mil) and nonflammability, material has tensile strength (6000-11,000 lbs. per sq. in.); low thermal conductivity; availability in colors, and low moisture absorption. Used for knobs, handles and electric insulating parts.

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Mineral filled — Similar material to above but has higher heat resistance and lower moisture absorption than cellulose filled material.

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Fabric filled — Similar material to cellulose Bakelite but contains chopped fabric giving high impact resistance, as well as abrasion resistance and high dielectric strength (300-400 volts per mil). Used for gears, bushings, bearings and lever handles or parts requiring resistance to shock.

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Laminated materials — Furnished in laminated sheets, tubes and rods; machined into part. Principal properties are resistance to shock, high dielectric strength and low oil absorption. Translucent in some forms; tensile strength (8500-24,000 lbs. per sq. in.), and flexible in sheet forms. Used for gears, bushings, etc., and parts requiring shock resistance and no oil absorption.

- - - - - - - 7 8 9 -

Cast resinol C-1 and C-25—Furnished in sheets, tubes, rods and special forms; cast and machined into parts. Principal properties are translucence, high polish, and availability in colors. Other properties similar to mineral and cellulose filled materials. Used for decorative fittings and for transparent gages and instruments or parts requiring resistance to hydrofluoric acid.

- - 3 - - - - 8 9 -

BEETLE—Beetleware Division, American Cyanamid Co., New York. Urea formaldehyde base, thermosetting material; furnished in resin for laminating; molded into parts. Besides availability in colors, resistance to shock and translucence, material has high polish, dielectric strength (280 volts per mil), tensile strength (5500-7000 lbs. per sq. in.) and nonflammability. Used for housings, cabinets, knobs, dials, panels and insulators. Material is available with slightly different properties for specific applications.

- 2 - 4 - - - - 9 -

BOOTH FELT—Booth Felt Co. Inc., Brooklyn, N. Y. Wool base felt; furnished in sheets or strips; machined and stamped into parts. Principal properties are heat resistance (400 degrees Fahr.), high tensile strength for type of material (5 to 100 lbs. per sq. in.) and availability in colors. Available in a variety of types and grades for uses such as washers, gaskets, grease seals, and pads for insulating machinery or reducing vibration.

For further information see ad. on page 7D.

C

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CATALIN — Catalin Corp., New York. Phenolic base, thermosetting material; furnished in sheets, rods, or special castings. Besides dielectric strength, nonflammability and low moisture absorption, material has high tensile and compressive strengths, availability in colors, and insolubility in ordinary solvents. Used for clock and instrument cases, auto fittings, knobs for electrical appliances, etc.

1—Corrosion resistance; 2—High heat resistance; 3—Impact resistance; 4—High tensile strength; 5—High dielectric strength; 6—Nonflammable; 7—Takes high polish; 8—Translucence; 9—Available in colors; 10—Low moisture absorption

Sleeve BEARING DATA

SHEET-METAL SLEEVE-TYPE BEARINGS

SHEET metal bearings came into use more as an economy measure than as an engineering advancement. By reason of their base material, they do not possess the many bearing characteristics found in cast bronze.

The material in most common use is rolled bronze strip. Two alloys, namely: Copper 90%; Tin .5%; Zinc 9.5% and Copper 88%; Tin 4%; Lead 4%; Zinc 4% are the most popular. The chemical composition of either of these materials changes somewhat due to the cold working of the alloy in the process of producing strip metal.

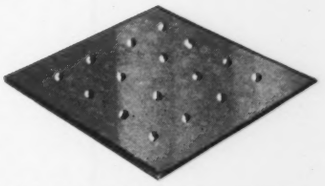
Sheet bronze bearings are most economical where production is sufficiently large to warrant the expenditure for blanking and forming tools required for each individual size. This type is always made to customer's specifications as no additional machining work can be done. Sheet bronze bearings are burnished in place, in order to iron out all irregularities and to impart an accurate and smooth bearing surface.

In order to provide the proper amount of burnishing stock, it is advisable to specify the bore of the housing rather than the outside diameter of the bearing.

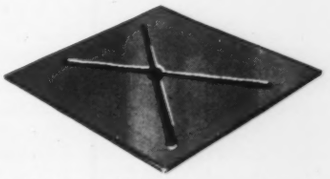
Sheet metal bearings are also available in laminated form. In this type, a thin layer of babbitt is bonded to strip steel before forming. All sheet metal bearings are available either plain or graphited. Any type oil groove, indentation, or oil hole can easily be added.

Engineers and Designers

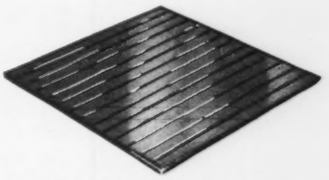
This is but one of a series dealing with the Fundamental Facts concerning Sleeve-Type Bearings. Why not write today for the entire series? There is no obligation.



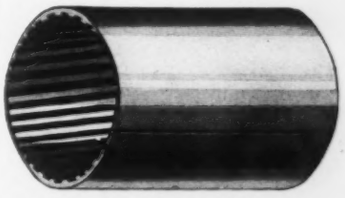
Indentations for retaining grease are placed in metal before forming.



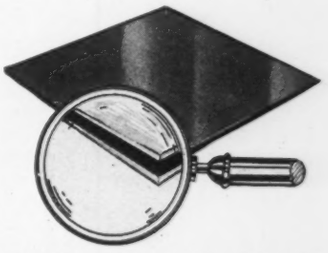
Oil grooves, oil holes, etc., are formed by progressive dies.



Serrations for retaining graphite are CUT into the bearing surface. Forming operation produces a dovetail effect.



The completed bearing, ready for pressing-in and reaming. Large runs are formed by progressive dies. Short ones are blanked, then formed.



Babbitt is bonded to thin sheet steel for Laminated Sheet Metal Bearings.

JOHNSON BRONZE COMPANY
525 SOUTH MILL STREET • NEW CASTLE, PA.
Sleeve BEARING HEADQUARTERS

1 2 - - - 6 - - -

CELITE—Johns-Manville, New York. Diatomaceous silica material; furnished in powdered, granular and brick forms. Principal properties are resistance to chemical corrosion, heat resistance and nonflammability. Used for insulation of equipment operating in high temperatures.

1 2 - - - - - - - - 10

CELLANITE—Continental-Diamond Fibre Co., Newark, Del. Resinous base, thermosetting material; furnished in laminated form, for machining into parts. Besides corrosion resistance, heat resistance, and low moisture absorption, material has high dielectric strength, tensile strength, and thermal insulating properties. Odor repellant. Used for frost breaker strips on refrigerator cabinets and many other applications.

- - - 4 - - 7 - 9 -

CELLULOID — Celluloid Corp., Newark, N. J. Cellulose nitrate base, thermoplastic material; furnished in sheet form or rods and tubes, for molding, machining or stamping into parts. Besides availability in colors, high polish and tensile strength (5000-10,000 lbs. per sq. in.) material has flexibility, resistance to corrosion, dielectric strength (600-1200 volts per mil) and transparence. Used for instrument dials, tool handles, key buttons, register wheels, etc.

1 - 3 - - - - 8 - -

CEL-O-GLASS—E. I. du Pont de Nemours & Co., Wilmington, Del. Plastic coated wire mesh which transmits ultraviolet rays. Besides corrosion resistance, resistance to shock and translucence, material is flexible and very light in weight. Used for sign boards, display backgrounds or any place where a translucent, flexible material is required.

1 - 3 4 - - - - - -

CELORON — Continental-Diamond Fibre Co., Newark, Del. Resinous base, thermosetting material; furnished in molded laminated form, for machining into parts. Besides corrosion resistance, resistance to shock and tensile strength, material has low moisture absorption, high heat resistance and abrasion resistance. Grade C (canvas base) used for heavy duty gears. Type L (linen base) used for small gears of fine pitch and narrow face.

1 2 - 4 - - - - - -

CETEC—General Electric Co., Pittsfield, Mass. Two types, nonrefractory material containing asphalt as a binder and asbestos as a filler, and refractory containing cement and drying oils as a binder with an asbestos filler; cold molded at room temperatures and heat treated for strength and toughness. Principal properties are corrosion resistance, heat resistance and high tensile strength. Not recommended for parts requiring high dielectric strength or thin sections.

For further information see ad. on page 2D.

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CODITE—Continental-Diamond Fibre Co., Newark, Del. Vulcanized fibre, thermoplastic material; furnished in molded sheets, rods and tubes, for machining into parts. Besides tensile strength, dielectric strength and translucence, material has flexibility and high polish. Used for washers and parts requiring a hard, tough, flexible material.

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COLASTA No. 56 — Specialty Insulation Mfg. Co. Inc., Hoosick Falls, N. Y. Resinous material compounded with small percentage of rubber. Principal properties are corrosion resistance, dielectric strength and low moisture absorption. Developed for aircraft magneto applications; highly resistant to carbon tracking; impervious to oil and weak acids.

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CORINCO—Cork Insulation Co. Inc., New York. Isolation corkboard for control of noise and vibration in machinery; proper density to withstand machinery loads.

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CORINCO—Cork Insulation Co. Inc., New York. Cork material; furnished in boards and panels. Principal properties are corrosion resistance, heat resistance and low moisture absorption. Material is nonflammable and has high dielectric strength. Used for noise and vibration dampening in machines. Available in proper densities to withstand machinery loads.

1 2 - - - - - - - - 10

CORPRENE — Armstrong Cork Products Co., Lancaster, Pa. Cork and synthetic rubber compound; cold molded into parts. Besides corrosion resistance, comparatively high heat resistance and low moisture absorption, material has surface giving high coefficient of friction, extreme resistance to oil, oxidation, corona and weather. Used for sealing on gaskets, valve disks and valve packings, etc.

D

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DIAMOND — Continental-Diamond Fibre Co., Newark, Del. Vulcanized fibre, bone-like material; furnished in sheets, rods and tubes, for machining, sawing or punching into parts. Besides tensile and dielectric strength and low specific gravity, material is tough, pliable and easily machined into parts. Used for insulating members, gears, bobbin heads, etc.

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DILOPHANE—Continental-Diamond Fibre Co., Newark, Del. Resinous base, thermosetting material; furnished in laminated sheet form, for machining, stamping and forming into parts. Besides availability in colors, translucence and nonflammability, material has dielectric strength (450-600 volts per mil.), tensile strength (12,000-13,000 lbs. per sq. in.), resistance to impact, heat resistance (275 degrees Fahr.), flexibility, and high polish. Used for radio and clock dials, insulating parts where color and appearance are important.

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DILECTO — Continental-Diamond Fibre Co., Newark, Del. Phenolic base, thermosetting material; furnished in laminated sheets, rods and tubes, for machining and stamping into parts. Besides dielectric strength (270-500 volts per mil), low moisture absorption and tensile strength (10,000 to 25,000 lbs. per sq. in.), material has resistance to corrosion, heat resistance (290 degrees Fahr.), availability in colors, resistance to shock and insolubility. Used for electrical, thermal and mechanical insulating parts.

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DUFELT—Felters Co. Inc., Boston, Mass. Felt in form of laminated washers for oil and grease retainment. Principal properties are corrosion resistance, dielectric strength and low moisture absorption. Company produces other forms and shapes to provide resiliency, isolate sound, absorb vibration and shock and to insulate from heat

For further information see ad. on page 33D.

or cold. Other uses include covers for polishing rolls, wicks for lubrication of bearings, dustproofing and filtering.

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DUPRENE—See under Neoprene.

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DUREZ—General Plastics Inc., North Tonawanda, N. Y. Phenolic base, thermosetting material; furnished in powder form, for molding into parts. Besides resistance to corrosion, high polish (comes from mold with lustrous finish), and low moisture absorption, material has heat resistance (350-450 degrees Fahr.), tensile strength (4000-6000 lbs. per sq. in.), availability in colors, resistance to shock, and abrasion resistance. Used for housings, handles, bases, electrical parts, small gears, frames, hoods, etc.

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DURITE — Durite Plastics, Division of Stokes & Smith Co., Philadelphia. Phenol furfural base, thermosetting material; furnished in powder; molded into parts. Besides heat resistance (280-500 degrees Fahr.), tensile strength (5000-10,000 lbs. per sq. in.) and dielectric strength (400-600 volts per mil), material has resistance to impact, high polish, translucence in resin form, availability in colors and insolubility in ordinary solutions. Used for cabinets, housings, handles, keys, knobs, etc. Material is available with wood flour, asbestos and fabric fillers and in cloth and fabric laminated forms.

E

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EBROK — The Richardson Co., Melrose Park, Ill. Acid resisting plastic material for specific requirements including such parts as battery containers.

For further information see ad. on page 33D.

- 2 - 4 - 6 - - - -

EEL-SLIP — Johns-Manville, New York. Asbestos, fiber, graphite and rubber compound. Principal properties are heat resistance, tensile strength and nonflammability. Used for bearings, suction box covers, etc.

F

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FARLITE—Farley & Loetscher Mfg. Co., Dubuque, Iowa. Phenolic and urea base, thermosetting material; furnished in laminated sheet form, for machining and stamping into parts. Besides resistance to corrosion, high polish and low moisture absorption, material has impact resistance, translucence, availability in colors, tensile strength (6000-8000 lbs. per sq. in.), and dielectric strength (200-400 volts per mil). Used for sawed or stamped flat parts for light machine members.

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FARLITE LOETEX—Farley & Loetscher Mfg. Co., Dubuque, Iowa. Fibrous synthetic core with laminated Bakelite surface, thermosetting material; furnished in sheets, for machining into parts. Besides dielectric strength (250 volts per mil), resistance to corrosion and high polish, material has resistance to impact, low moisture absorption, tensile strength (5000-6000 lbs. per sq. in.), and heat resistance (250 degrees Fahr.) Used for low voltage insulation with moderate strength.

1—Corrosion resistance; 2—High heat resistance; 3—Impact resistance; 4—High tensile strength; 5—High dielectric strength; 6—Nonflammable; 7—Takes high polish; 8—Translucence; 9—Available in colors; 10—Low moisture absorption

• If you figure carburizing costs on a part basis, Chrome-Molybdenum (4120) carburizing steel will save several cents per part.

If you figure them on a volume, the savings will run into many dollars.

Chrome-Moly's first cost is lower than that of any other successful alloy carburizing steel. It carburizes with minimum predictable distortion. It machines readily.

Chrome-Moly carburized parts show excellent service records. The steel takes an exceptionally hard, wear-resistant case, and develops good case properties.

This steel has proved an effective answer to the vital question of cutting costs and still maintaining quality. It will well repay investigation. Complete information on request. Climax Molybdenum Co., 500 Fifth Avenue, New York City.

PRODUCERS OF FERRO-MOLYBDENUM, CALCIUM MOLYBDATE AND MOLYBDENUM TRIOXIDE

VISIT OUR BOOTH, C-15, AT THE NATIONAL METALS EXPOSITION

Climax Mo-lyb-den-um Company

MOLY

1 - - - - - - - 8 9 -

FIBERLOID—The Fiberloid Corp., Indian Orchard, Mass. Cellulose nitrate base, thermoplastic material; furnished in sheets, rods and tubes, or in laminated form, for machining, molding, stamping, swedging or blowing (steam) into parts. Besides resistance to corrosion, translucence, and availability in colors, material has flexibility, dielectric strength (750-900 volts per mil), tensile strength (6000-9000 lbs. per sq. in.) and low moisture absorption. Used for sight glasses, safety glass, oilproof insulation, dial covers, knobs, handles and structural models for strain study.

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FIBERLON—The Fiberloid Corp., Indian Orchard, Mass. Phenolic base, thermosetting material; furnished in sheets, rods and tubes, or laminated form; cast and machined into parts. Besides translucence, dielectric strength (250-700 volts per mil), and corrosion resistance, material has tensile strength (6000-11,000 lbs. per sq. in.), high polish, low moisture absorption (0.05-0.07 per cent), and availability in colors. Used for safety shields, electrically insulated knobs and handles and structural models for strain study.

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FIBESTOS—The Fiberloid Corp., Indian Orchard, Mass. Cellulose nitrate base, thermoplastic material; furnished in sheet, laminated and powder forms or rods and tubes, for molding, machining, stamping or swedging into parts. Besides resistance to corrosion, transparence and availability in colors, material has flexibility, high polish, dielectric strength (540-1800 volts per mil) and tensile strength (6000-6800 lbs. per sq. in.) Used for safety glass, compressible shims, couplings, gaskets, electrically insulated knobs and handles.

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FORMICA—Formica Insulation Co., Cincinnati. Resinous base, thermosetting material; furnished in laminated form; machined or stamped into parts. Principal properties are corrosion resistance, tensile strength (slightly less than cast iron), and dielectric strength. Asborbs no oil and changes in dimensions only slightly as the result of moisture absorption. Material has good insulating qualities. Used for insulating washers and bushings, punched parts in switches, automotive starting systems and for all types of heavy duty gears.

For further information see ad. on poge 4D.

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FYBEROID — Wilmington Fibre Specialty Co., Wilmington, Del. Paper base material; furnished in sheet form, for machining or stamping into parts. Besides dielectric strength (200-400 volts per mil), tensile strength (5000-8000 lbs. per sq. in.) and flexibility, material has abrasion and corrosion resistance. Used for insulation on motors, generators, automotive ignition starters, etc.

For further information see ad. on page 45D.

G

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GUMMON — Garfield Mfg. Co., Garfield, N. J. Black, thermosetting material. Besides corrosion and heat (400 degrees Fahr.) resistance, and high dielectric strength, material has high polish, and resistance to hot oil. Will not shrink, crack, warp or deteriorate with age. Used for insulated parts such as wiring devices and other small units.

H

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HARVITE—Siemon Co., Bridgeport, Conn. Shellac base, thermosetting material; molded into parts. Besides corrosion resistance, low moisture absorption and availability in colors, material has comparatively high heat resistance (175 degrees Fahr.) and dielectric strength. Used for insulated switch handles and as electric insulator.

1 2 3 - - - - - - - -

HAVEG — Haveg Corp., Newark, Del. Phenolic base, thermosetting material; furnished in finished form; molded and machined into parts. Besides corrosion resistance, heat resistance (275 degrees Fahr.) and resistance to shock, material has abrasion resistance, tensile strength (5600 lbs. per sq. in), low moisture absorption and nonflammability. Used for chemical equipment and parts where chemical resistance is an important factor.

1 2 - - - - - - - - 10

HAVEGIT — Haveg Corp., Newark, Del. Phenol formaldehyde base, thermosetting cement. Principal properties are corrosion resistance (acids), heat resistance and low moisture absorption. Properties similar to Haveg. Used in setting up brick and tile linings in chemical equipment.

1 2 - - - - - - - - 10

HEMIT—Garfield Mfg. Co., Garfield, N. Y. Gray-white material. Principal properties are corrosion resistance, heat resistance (1100-1500 degrees Fahr.), and low moisture absorption. Used for interior parts of heating devices, such as arc shields or where a molded part must withstand an arc. Specially impregnated for moisture resistance.

I

- - - 4 5 6 - - - -

INDUR—Reilly Tar & Chemical Corp., Indianapolis. Phenolic base, thermosetting material; furnished in powder form, for molding into parts. Besides tensile strength (7200 lbs. per sq. in.), dielectric strength and nonflammability, material has corrosion resistance, availability in colors and low specific gravity (1.2-1.9). Used for instruments and machine accessories, including insulating panels, knobs and handles.

- - - 4 5 6 - - - -

INDUR VARNISH—Reilly Tar & Chemical Corp., Indianapolis. Phenolic base, thermosetting material; furnished in liquid form, for molding into parts. Principal properties are dielectric strength, tensile strength, and nonflammability.

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INSULKOTE — Johns-Manville, New York. Weatherproof coating for use over insulation of ducts and other exposed equipment. Principal properties are corrosion resistance, heat resistance and low moisture absorption.

- - 3 4 - - - - - 10

INSUROK—The Richardson Co., Melrose Park, Ill. Phenolic base, thermosetting material; furnished in laminated sheets, rods and tubes for machining into parts, or as finished molded parts. Properties include corrosion resistance, low moisture absorption, tensile strength, resistance to shock and comparatively low specific gravity. Used for gears, bearings and parts requiring impact and corrosion resistance. Material available in different grades for various applications.

For further information see ad. on page 39D.

K

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KASOLOID—Synthetic Plastics Co., Newark, N. J Casein base, thermoplastic material. Principal properties are corrosion resistance, high polish and availability in colors. Material is slightly hygroscopic, therefore unfit for parts where accurate dimensions are important. Used especially for small objects where brilliant color and high luster are desired. Natural color is blond.

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KOMPO-KORK—Korfund Co. Inc., Long Island City, N. Y. Plates of finely granulated compressed cork with an oxidized linseed oil binder and burlap backing. Principal properties are corrosion resistance, shock resistance and low moisture absorption. Used where irregularly shaped plates are required for isolating light machinery to combat vibration.

1 - 3 - - - - - - - 10

KORFUND—Korfund Co. Inc., Long Island City, N. Y.—Resilient mat of pure natural cork, steel bound and oil treated. Principal properties are corrosion resistance, resistance to shock and low moisture absorption. Material is unaffected by water, acids and temperature changes. Used as machine bases to reduce vibration. Another isolator developed by the company is identical in construction, but is bound with asphalt and felt.

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KORK-RUBBER—Korfund Co. Inc., Long Island City, N. Y.—Plates of finely granulated cork and rubber particles compressed together. Used for vibration dampening of light machines. Principal properties are corrosion resistance, shock resistance and low moisture absorption.

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KOROSEAL—B. F. Goodrich Co., Akron, O. Synthetic rubber; furnished in various consistencies from jelly to bone-like hardness. Principal properties are corrosion resistance, resistance to shock and availability in colors. Jelly is used for making molds for plastic casts, but other compounds sold only as finished products. Superior to rubber in flexing, oxidation and penetration of moisture or gases. Does not swell in oil. Available in molded and extruded forms; also applied as coating to paper and fabric.

L

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LACANITE — Consolidated Molded Products Corp., Scranton, Pa. Shellac base, thermoplastic material; furnished in sheet form, for molding into parts. Besides low moisture absorption, high dielectric strength and corrosion resistance, material has tensile strength (1000-2000 lbs. per sq. in.), nonflammability and availability in colors. Used principally for electrical apparatus on machines.

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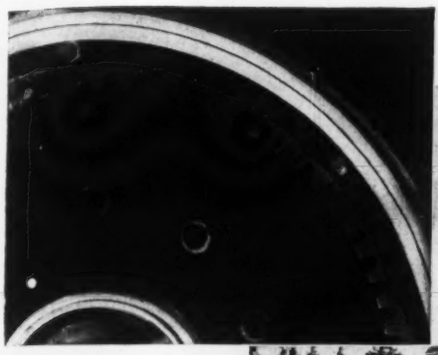
LAMICOID — Mica Insulator Co., New York.

- 2 - 4 - - - - - 10

Paper filled, phenolic base, thermosetting material; furnished in sheet and

1—Corrosion resistance; 2—High heat resistance; 3—Impact resistance; 4—High tensile strength; 5—High dielectric strength; 6—Nonflammable; 7—Takes high polish; 8—Translucence; 9—Available in colors; 10—Low moisture absorption



DuFELT between the wheel gear and the wheel hub is used as a seal for the gears in the high-powered Walter Four Point Positive Drive Tractor Trucks and Snow Fighters.

ENGINEERS ARE DOING THINGS WITH

THE WALTER HAULING 40 TONS OF LOGS

FELTERS DuFELT

NEOPRENE — LAMINATED

DuFELT is an industrial product that has earned high ranking in hard service — a material that has come into wide industrial use on its record of incomparable fitness for the job, its thoroughgoing performance on the job.

Felters DuFELT (Neoprene-laminated) asks no favors on the assembly line nor in the field. Because it is engineered by *Felters* to close tolerances, it needs no fitting, pushing or special handling in assembly. Because it is made of wear — and deterioration-resisting *Felters Felt* and oil-sealing, dirt-excluding Neoprene laminations in various combinations, it performs efficiently and enduringly under the most adverse conditions of service.

DuFELT is resistant to the action of all petroleum products — resists oxidation (does not become hard and brittle with age) — does not vary in size with temperature changes — retains its bonding properties and elasticity consistently in the presence of oil — stands heat over long periods without softening or breaking up.

Engineers are doing things with DuFELT — and DuFELT is doing things for their products. If the product you manufacture calls for efficient, long-lasting washers, gaskets or other oil sealing, dirt, — moisture — or fume-resisting forms, try DuFELT. It will stand up and do its duty where other products fail. Your inquiry will bring full engineering cooperation.

THE FELTERS COMPANY, INC.

Manufacturers of Felt and Felt Products

210 SOUTH STREET, DEPT.-MD BOSTON, MASS.

Mills: Millbury, Mass., Johnson City, N. Y., Jackson, Mich.

Offices: New York, Chicago, Philadelphia, St. Louis, Dallas, Detroit, San Francisco, Mexico City

laminated forms or rods and tubes; machined and stamped into parts. Besides tensile strength (7000-8000 lbs. per sq. in.), heat resistance (250 degrees Fahr.) and low moisture absorption (1-6 per cent), material has dielectric strength (500 volts per mil), high polish, nonflammability, and availability in colors. Used for panel boards, gears, thrust washers, valves, bushings, barriers and punchings.

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Fabric filled—Similar material to above but has higher tensile strength (9000-10,000 lbs. per sq. in.) and lower moisture absorption (1½-2½ per cent).

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Micoid—Similar to above materials but is available in black and brown colors. Tensile strength and dielectric strength slightly lower than above materials.

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LIGNOTITE—Lignotite Co., Chicago. Casein base, thermoplastic material; furnished in powder form for hot molding into parts. Besides corrosion resistance, tensile strength and dielectric strength, material has heat resistance and low moisture absorption.

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LUCITE—E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. Polymethylmethacrylate base, thermoplastic material; furnished in powder form or in sheets, rods and tubes, for molding, casting and machining into parts. Besides translucence, availability in colors, resistance to shock and low moisture absorption, material has high polish, resistance to corrosion, tensile strength (8000-10,000 lbs. per sq. in.) and heat resistance (195-235 degrees Fahr.). Used for panels, knobs, models, safety guards, dials and gage glasses.

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LUMARITH — Celluloid Corp., Newark, N. J. Cellulose acetate base, thermoplastic material; furnished in sheets, powder or rods and tubes. Besides availability in colors, tensile strength (6000-11,000 lbs. per sq. in), and dielectric strength (800-2500 volts per mil), material has high polish, flexibility, resistance to shock and transparence. Used for instrument dials, handles, knobs, register wheels, key buttons, electrical insulated parts, etc.

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MAKALOT—Makalot Corp., Boston. Synthetic resinous base; furnished in powder form and also as varnish and cement, for molding into parts. Besides tensile strength, dielectric strength and low moisture absorption, material has heat resistance, abrasion resistance and nonflammability. Flowing and covering characteristics of material eliminate sticking troubles. Used where high strength and shock resistance are important.

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MARBLETTE — Marblette Corp., Long Island City, N. Y. Phenolic base, thermosetting material; cast into parts and machined into finished form. Principal properties are corrosion resistance, dielectric strength and high polish. Material is softer than molded plastic and can be easily turned, drilled, sawed, threaded or carved.

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MICABOND — Continental-Diamond Fibre Co., Newark, Del. Fibrous, flexible material; furnished in sheets and tubing, for machining and forming into parts. Principal properties are heat resistance, dielectric strength and low moisture absorption. Used for V-rings, washers, segments and various special shapes.

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MICARTA—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Phenolic base, thermosetting material; furnished in sheet and laminated form or rods and tubes, for machining or punching into parts. Besides dielectric strength (150-180 volts per mil), low moisture absorption (0.5-5 per cent in 24 hrs) and resistance to shock, material has corrosion resistance, high polish, flexibility, tensile strength (7000-15,000 lbs. per sq. in.) and availability in colors. Used for bearings, gears, thermal and electrical insulation and parts exposed to acids, alkalies and common solvents.

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NATIONAL CARBON — National Carbon Co. Inc., Cleveland. Carbon or graphite in amorphous or graphite form; made in a variety of shapes; molded, extruded or machined into parts. In graphitic form carbon possesses excellent lubricating properties. It is highly resistant to most acids, alkalies and solvents. Used for sleeve bearings, packings, threaded parts, nozzles for corrosive liquids, etc.

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NATIONAL FIBRE—National Vulcanized Fibre Co., Wilmington, Del. Cotton cellulose base, vulcanized fiber; available in hard fiber form and flexible fiber; furnished in sheets, rolls, tubes and rods, for machining or stamping into parts. Besides dielectric strength, availability in colors, tensile strength (5000-8000 lbs. per sq. in.), low moisture absorption, material has resiliency, toughness, and plasticity when heated. Used for valves, gaskets, packings and washers.

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NEILLITE—Watertown Mfg. Co., Watertown, Conn. Phenolic base, thermosetting material; molded into parts. Principal properties are tensile strength, dielectric strength and corrosion resistance. Used for mechanical and electrical purposes.

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NEOPRENE—E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. Synthetic rubber-like material, formerly known as Duprene; furnished in hose form, belting, sheets, gaskets, tubing and molded parts; compounds with coke, asbestos, felt and canvas. Besides corrosion resistance and high resistance to oil, heat resistance (300 degrees Fahr.) and low moisture absorption, material has abrasion resistance, tensile strength (few compounds as high as 4000 lbs. per sq. in.) and availability in colors. Used for many machine applications where resilience and elasticity are required as in rubber, but where resistance to deteriorating agents is important.

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NIGRUM—Bound Brook Oil-less Bearings Co., Bound Brook, N. J. Impregnated wood bushings, bearings and washers.

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0-1 FIBERGLAS—Owens-Illinois Glass Co., Newark, O. Glass; furnished in mineral wool form. Principal properties are nonflammability, light weight and high insulating value. Others include resistance to corrosion and low moisture absorption. Material is downy white and is placed between walls for insulation purposes. Used in refrigerator cabinets and as filters in air-conditioning equipment.

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OHMOID—Wilmington Fibre Specialty Co., Wilmington, Del.—Phenolic base, thermosetting material; furnished in laminated sheets, rods and tubes, for machining or stamping into parts. Besides dielectric strength (200-700 volts per mil), low moisture absorption (2 per cent) and insolubility in ordinary solvents, material has high polish, corrosion resistance, tensile strength (10,000-14,000 lbs. per sq. in.) and heat resistance (250-300 degrees Fahr.) Used for electric and mechanical insulation.

For further information see ad. on page 45D.

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PANELYTE—Panelyte Corp., Trenton, N. J. Phenolic base, thermosetting material; furnished in sheet and laminated forms or rods and tubes, for molding, machining or stamping into parts. Besides resistance to corrosion, dielectric strength (500-1200 volts per mil) and low moisture absorption (under 1 per cent), material has high polish, low specific gravity (1.38), heat resistance (350 degrees Fahr.) and translucence. Used for gears, pinions, structural parts, bearings, bushings, etc.

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PEERLESS — National Vulcanized Fibre Co., Wilmington, Del. Cotton rag base, fish paper insulation; furnished in rolls. Principal properties are high dielectric strength and low moisture absorption. Used extensively for generator and motor insulation and various electrical applications.

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PHENALINE—E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. Phenolic base, thermosetting material; furnished in sheets, rods and tubes; cast and machined into parts. Besides availability in colors, nonflammability and resistance to corrosion, material has high polish, dielectric strength (250-700 volts per mil), tensile strength (8000-11,000 lbs. per sq. in.) and transparence. Used for handles and knobs.

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PHENOLITE—National Vulcanized Fibre Co., Wilmington, Del. Laminated Bakelite; furnished with base of special paper, canvas or linen, for machining into parts. Besides dielectric strength, availability in colors and low moisture absorption, material has heat resistance (280-360 degrees Fahr.), corrosion resistance and resistance to shock. Can be sawed, turned, drilled and threaded. Used for silent gears and pinions, bushings, bearings, valve disks and many electrical applications.

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PLASKON—Plaskon Co. Inc., Toledo, O. Urea formaldehyde base, thermosetting material; furnished in powder form, for molding into parts. Besides translucence, tensile strength (8000-13,000 lbs. per sq. in.), and availability in colors, material has corrosion resistance, high polish, dielectric strength (270 volts per mil), heat resistance (167 degrees Fahr), resistance to shock and low moisture ab-

1—Corrosion resistance; 2—High heat resistance; 3—Impact resistance; 4—High tensile strength; 5—High dielectric strength; 6—Nonflammable; 7—Takes high polish; 8—Translucence; 9—Available in colors; 10—Low moisture absorption

IF YOU REQUIRE A NON-FERROUS ALLOY THAT PROVIDES THE UTMOST IN

✓WEAR RESISTANCE
✓TENSILE STRENGTH
✓CORROSION RESISTANCE

...THEN YOU HAVE A JOB FOR AMPCO METAL

PERHAPS you feel you know Ampco Metal . . . since it has become an increasingly important factor in the non-ferrous field during the last twenty years . . . or, perhaps, you just accept it as a bronze alloy possessed of an unusually stubborn resistance to wear.

But, actually, the versatility of Ampco Metal will amaze you . . . for we, ourselves, as the producers of Ampco, are often genuinely surprised at its extraordinarily wide range of application. Time and again Ampco Metal has proved its versatility in a wide variety of adaptations, ranging from cams, shifters, nuts, gears, bushings and bearings, to forming and drawing dies and acid resistant equipment. Time and again it has proved not only that it can outlast other bronzes in difficult services, but also that it can actually outwear hardened steel.

In some one of its six grades Ampco Metal can probably lick a problem for you . . . why not check with us.

AMPCO METAL, INC.
Dept. MD-10, Milwaukee, Wis.

PROPERTIES OF AMPCO METAL—GRADE 18

NOTE: Grade 18 is adaptable to a wide range of application; but its prime fields of service are gears, worm wheels, heavy bearings and acid resistant equipment.

Ultimate Tensile Strength (lbs. per sq. in.)	75,000 - 85,000
Yield Point (lbs. per sq. in.)	33,000 - 42,000
Elongation % in 2 inches	10 - 14
Red. of Area % in 2 inches	6 - 10
Brinell Hardness 3000 Kg. Load	167 - 179

Rockwell Hardness		85 - 87 - B
Scleroscope Hardness		26 - 28
Young's Modulus		14,350,000
Charpy Impact Value		17.4
Mean Analysis	% Copper	84.60
	% Aluminum	11.30
	% Iron	3.70
	% Special Agent	0.40
Weight lbs. per cubic inch		.270

AMPCO METAL

"The Metal without an Equal"

BEFORE YOU SPECIFY . . . INVESTIGATE AMPCO

sorption (1-2 per cent). Used for housings, trim, knobs, dials, etc.

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PLASTACELE—E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. Cellulose acetate base, thermoplastic material; furnished in powder, sheets, rods and tubes, for machining and molding into parts. Besides availability in colors, transparence and resistance to shock, material has high polish, corrosion resistance, flexibility, dielectric strength (700-1000 volts per mil), tensile strength (3000-8000 lbs. per sq. in.) and heat resistance (185-250 degrees Fahr.). Used for machine guards, models, control panels, dials, knobs, safety glass screens, etc.

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PLEXIGLAS—Rohm and Haas Co. Inc., Philadelphia. Acrylic base, thermoplastic material; furnished in sheet form; cast into shape. Besides corrosion resistance, resistance to shock and translucence, material has flexibility, low specific gravity (1.18), tensile strength (7000-9000 lbs. per sq. in.), availability in colors and high polish. Used for inspection windows.

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PLIOFORM—Goodyear Tire & Rubber Co., Akron. O. Resin that is synthetic derivative of natural rubber; furnished in two grades, for molding into parts. Besides corrosion resistance, resistance to shock and low moisture absorption, material has hardness, toughness and dielectric strength. May be molded by the application of heat without use of sulphur.

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POLAROID—The Polaroid Corp., Boston. Light-polarizing glass; furnished in thin, transparet sheets for laminating into finished product. Principal properties are corrosion resistance, nonflammability and transparence. Used for camera filters, polarizing attachments of microscopes, refractometers and other scientific instruments. Material also finds applications in model structures to determine strain, three dimensional motion picture apparatus, glareless auto headlights, etc.

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PRYSTAL—Catalin Corp., New York. Phenolic base, thermosetting material; furnished in sheets, rods or special castings, cast into parts. Besides nonflammability, translucence and low moisture absorption, material has high dielectric strength, corrosion resistance and high refractory index. Material has applications where it is used to replace glass.

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PYRALIN—E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. Nitocellulose base, thermoplastic material; furnished in molded sheets, rods and tubes; for machining into parts. Besides transparence, availability in colors and resistance to shock, material has corrosion resistance, high polish, flexibility, dielectric strength (300-750 volts per mil) and tensile strength (5000-10,000 lbs. per sq. in.). Used for handles, gage glasses, instrument covers, models, safety glass screens, etc.

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PYREX—Corning Glass Works, Corning, N. Y. Ceramic base, thermoplastic material; furnished in sheets and laminated forms and rods or tubes; molded or cast into shape. Besides extremely high heat resistance, great corrosion resistance and translucence, material has high polish, dielectric strength, low moisture absorption and nonflammability. Used for wide variety of parts where resistance to chemical action and high temperature is required.

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PYROFLEX—Maurice A. Knight, Akron, O. Depolymerized colloidal resin base, thermoplastic material; furnished in liquid or sheet form; applied by dipping or cementing sheets to parts. Principal properties are corrosion resistance, dielectric strength and low moisture absorption. Good bonding material where temperatures are not too high.

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PYROPLAX — Cutler-Hammer Inc., Milwaukee. Asbestos base material; furnished in cold-molded pieces. Besides heat resistance (800-1000 degrees Fahr.), nonflammability and dielectric strength (40 volts per mil), material has resistance to corrosion and abrasion resistance. Used for machine parts where high temperature resistance is required.

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RESINOX—Resinox Corp., New York. Phenolic base, thermosetting material; furnished in powder form for molding into parts. Besides heat resistance, low moisture absorption and resistance to shock, material has availability in colors, corrosion resistance, high tensile strength, and high polish. Material is made in a number of molding powders each having slightly different properties. Used for electrical and mechanical parts.

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RESOGLAZ—Advance Solvents & Chemical Corp., New York. Molding material may be hot molded and does not cure. Besides resistance to shock, transparence and low moisture absorption, material resists dilute alkalies and acids, but is affected by oils.

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REVOLITE — Atlas Powder Co., Zapan Div., Stamford, Conn. Cloth base impregnated with Bakelite resin; furnished in laminated form. Besides heat resistance, dielectric strength and nonflammability, material has corrosion resistance, low moisture absorption and impact resistance. Used for cable wrappings, endless belts, diaphragms for pumps and valves, gaskets and flexible connections for machinery such as pulverizers where powder is handled.

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ROBERTSON FELT BONDED METAL — H. H. Robertson Co., Pittsburg, Pa. and Felters Co. Inc., Boston. Felt is bonded to metal by process which makes permanent bond. Felt may be on one or both sides of metal and metal may be bent or twisted without destroying bond. Principal properties are corrosion resistance, tensile strength, nonflammability, availability in colors and low moisture absorption.

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RUB-TEX—The Richardson Co., Indianapolis, Ind. Hard rubber material; molded into parts. Ideal where low cost is a special consideration. Adapted to many industrial uses.

S

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SELFVULC—Self-Vulcanizing Rubber Co. Inc., Chicago. Self, cold curing gum rubber; furnished in plastic or liquid form. Besides resistance to corrosion and abrasion, comparatively high tensile strength (2000 lbs. per sq. in.) and resistance to shock, material has flexibility, heat resistance (212 degrees Fahr.), low moisture absorption, and availability in colors. Used in machines to resist corrosion or abrasion, as a sound deadener and for insulation and waterproofing.

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SPAULDING ARMITE — Spaulding Fibre Co. Inc., Tonawanda, N. Y. Fibrous material; furnished in sheets and laminated forms for machining, stamping or forming into parts. Besides flexibility, dielectric strength (200-550 volts per mil) and compressive strength (40,000 lbs. per sq. in.), material has abrasion and corrosion resistance, tensile strength (9000-15,000 lbs. per sq. in.), availability in colors and high polish. Used where high dielectric strength, mechanical strength, toughness and forming properties are essential.

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SPAULDING FIBRE—Spaulding Fibre Co. Inc., Tonawanda, N. Y. Fibrous material; furnished in sheet and laminated forms or rods and tubes, for machining, stamping or forming into parts. Besides dielectric strength (150-400 volts per mil), tensile strength (9000-15,000 lbs. per sq. in.) and flexibility, material has abrasion resistance, corrosion resistance, availability in colors and resistance to shock. Used for mechanical applications where toughness, light weight and machining and forming properties are essential.

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SPAULDITE—Spaulding Fibre Co. Inc., Tonawanda, N. Y. Phenolic base, thermosetting material; furnished in sheet and laminated forms for rods and tubes for machining or stamping into parts. Besides dielectric strength (700 volts per mil); low moisture absorption and permanent fine appearance, material has high polish, corrosion resistance, heat resistance (220 degrees Fahr.), and resistance to shock. Used where resistance to moisture and chemicals, fine appearance and permanence are essential.

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SPAULDO — Spaulding Fibre Co. Inc., Tonawanda, N. Y. Fibrous material; furnished in sheet form for machining or stamping into parts. Besides flexibility, dielectric strength (300 volts per mil), and heat resistance (220 degrees Fahr.), material has high polish, corrosion resistance, tensile strength (8000 to 16,000 lbs. per sq. in.) and resistance to shock. Used for applications where flexibility and toughness in both grain directions are essential.

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SPRAYTEX—Monroe Auto Equipment Co., Monroe, Mich. Bituminous base liquid, sprayed on parts for soundproofing housings, covers and other large metal surfaces. Material is corrosion resistant, insoluble in ordinary solvents and heat resistant (250 degrees Fahr.).

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SYNTHANE—Synthane Corp., Oaks, Pa. Laminated Bakelite; furnished in sheets, rods, tubes and fabricated parts. Principal properties are corrosion resistance, tensile strength and dielectric strength. Used for gears, panels, bushings insulation, washers and vibration dampening devices.

1—Corrosion resistance; 2—High heat resistance; 3—Impact resistance; 4—High tensile strength; 5—High dielectric strength; 6—Nonflammable; 7—Takes high polish; 8—Translucence; 9—Available in colors; 10—Low moisture absorption

NEED MECHANICAL TUBING?

Reach for your telephone and call for SHELBY

WHEN you are designing machine parts, call the nearest SHELBY Distributor. You'll find him a specialist in tubular construction . . . able to offer valuable suggestions on practical design problems and ready to help you select the right type of tubing for the job.

Selection of the best type of tubing for a particular application is not always a simple task. These men *know* tubing from the inside out. They can draw on stocks of wide assortment — round, square, rectangular, oval, and other sections; numerous sizes, lengths, and wall thicknesses; various finishes and grades of steel. That's why it pays to call in the tubing specialist, your SHELBY Distributor, when designing parts that involve tubular sections. Find out what you can do with SHELBY Seamless Tubing.

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Phone: Washington 2000

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E. K. Morris & Company
311-323 W. Second Street
Phone: Main 1525

CLEVELAND, OHIO
The Strong, Carlisle & Hammond Company
1392 West Third Street
Phone: Main 6760

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Peter A. Frasse & Co., Inc.
12th and Provost Streets
Phone: Delaware 3-4888

LOS ANGELES, CAL.
Ducommun Metals & Supply Co.
219 to 227 Central Avenue
Phone: Trinity 0621

MONTREAL, CANADA
Lyman Tube & Supply Co., Ltd.

NEW ORLEANS, LA.
Standard Supply & Hardware Co., Inc.
822-838 Tchoupitoulas Street
Phone: Raymond 2251

NEW YORK, N. Y.
Peter A. Frasse & Co., Inc.
17 Grand Street
Phone: Walker 5-2200

PHILADELPHIA, PA.
Peter A. Frasse & Co., Inc.
3717 Wissahickon Avenue
Phones: Radcliffe 7100
Park 5541

PITTSBURGH, PA.
Williams & Co., Inc.
901-937 Pennsylvania Avenue
N. S. Pittsburgh, Pa.
Phone: Cedar 8600

PORTLAND, OREGON
Pacific Machinery & Tool Steel Co.
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Cragin & Company
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Phone: Elliot 0052

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NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

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TEGIT—Garfield Mfg. Co., Garfield, N. J. Brown or black plastic material. Besides corrosion resistance, high dielectric strength and low moisture absorption, material has heat resistance (300 degrees Fahr.) and high polish. Resists hot oil, boiling water and ordinary chemicals. Will not shrink, crack, warp or deteriorate with age. Used for wiring devices and small insulated parts.

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TENITE—Tennessee Eastman Corp., Kingsport, Tenn. Cellulose acetate base, thermoplastic material; furnished in granular and molding sheets for molding into parts. Besides high polish, availability in colors and resistance to shock, material has flexibility, tensile strength 3500 - 6200 lbs. per sq in.), and heat resistance (160 degrees Fahr.). Used for decorative applications.

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TEXTOLITE—General Electric Co., Schenectady, N. Y. Phenolic base, thermosetting material; furnished in sheets, laminated forms, and rods or tubes, molded into parts. Besides resistance to corrosion, tensile strength (5000-20,000 lbs. per sq. in.), and resistance to shock, material has dielectric strength (60-1000 volts per mil), heat resistance (266 to 400 degrees Fahr), availability in color, translucence in certain grades, and high polish. Used for electrical or thermal insulation, structural parts, gears, cams, bearings, housings, knobs, etc. Material is available in several forms, each having slightly different properties.

For further information see ad. on page 2D.

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THERMOPLAX — Cutler-Hammer, Inc., Milwaukee. Bituminous base compounded with filler such as asbestos; cold-molded into parts. Besides heat resistance (400-600 degrees Fahr.), nonflammability and dielectric strength (80-100 volts per mil), material has resistance to corrosion, high polish, tensile strength (2000-4000 lbs. per sq. in.) and low moisture absorption (2 per cent). Used for electrical and heat insulation.

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THIOKOL—Thiokol Corp., Yardville, N. J. Synthetic rubber, available in two types; furnished in powder or raw sheet form, corresponding to crude rubber; processed in manner similar to rubber. Principal properties are oil and corrosion resistance, resistance to shock and availability in colors. Used for hoses carrying oil or gasoline, gaskets, packing, pipeline rings, diaphragms, newspaper printing blankets, etc.

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TRANSITE—Johns-Manville, New York. Fireproof material in a variety of forms as hoods, dampers, baffles, electrical conduits where high dielectric strength is not required. Principal properties are resistance to corrosion, heat resistance, and nonflammability.

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UNYTE—Plaskon Co. Inc., Toledo, O. Urea-formaldehyde base, thermosetting material. Principal properties are translucence, low moisture absorption and nonflammability. Material is available in colors, free flowing, and capable of rapid cure.

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URALITE—Consolidated Molded Products Corp., Scranton, Pa. Urea-formaldehyde base, thermosetting material; furnished in powder, for molding into parts. Besides translucence, high polish, and insolubility in water, material has dielectric strength (300-500 volts per mil), tensile strength (8000-13,000 lbs. per sq. in.), nonflammability and availability in colors. Used principally for decorative items.

V

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VIBRACORK—Armstrong Cork Products Co., Lancaster, Pa. Resilient board of cork granules; furnished in board and panel forms; compressed and baked under pressure into parts. Three principal properties are corrosion resistance, heat resistance and low moisture absorption. Material is made in two densities for vibration dampening applications.

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VIBRO-PLATE—Korfund Co. Inc., Long Island City, N. Y. Material has permanent elastic core, consisting of a combination of several resilient elements. Principal properties are corrosion resistance, shock resistance and low moisture absorption. Used for pads to be placed under legs or bases of machines.

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VINYLITE—Carbide & Carbon Chemicals Corp., New York. Resinous base, thermoplastic material; furnished in sheets and coated paper, laminated coated cloth, powder, or rods and tubes; for molding, stamping or machining into parts. Besides resistance to corrosion, low moisture absorption and nonflammability, material has flexibility, high polish, availability in colors, translucence, moderate tensile strength, and dielectric strength (650 volts per mil). Immune to water, acids and alkalies. Uses include machine cabinets, electrical fixtures, etc.

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VITREOSIL — Thermal Syndicate Ltd., Brooklyn, N. Y. Ceramic base (fused silica, 99.8 per cent pure), nonplastic material; furnished in sheet and powder forms or rods and tubes; molded or drawn into parts. Besides low thermal expansion, high dielectric strength and extremely high heat resistance (1900 degrees Fahr.), material has high polish, corrosion resistance, low moisture absorption, and translucence. Used where high resistance to electrical, thermal, and corrosion extremes are required.

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VITRIC-10—United States Stoneware Co., Akron, O. Ceramic base, nonplastic material; furnished in powder form for casting into parts, or as complete parts. Besides corrosion resistance, heat resistance (1000 degrees Fahr.) and nonflammability, material has compressive strength (3500 lbs. per sq. in.), dielectric strength (40 volts per mil) and availability in colors. Used for cementing and sealing.

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VULCABESTON—Colt's Patent Fire Arms Mfg. Co., Hartford, Conn. Hard rubber and asbestos base, thermosetting material; furnished in sheet and laminated forms or rods and tubes for machining into parts or supplied as complete parts. Besides heat resistance (750 degrees Fahr.), tensile strength (7000 lbs. per sq. in.) and dielectric strength (40 volts per mil), material has corrosion resistance and low moisture absorption. Uses include insulation and brake linings.

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VULCO—See AJAX

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VULCOID — Continental-Diamond Fibre Co., Newark, Del. Resinous base, thermoplastic material; furnished in sheets and laminated forms, or rods and tubes for machining, stamping or forming into parts. Besides low moisture absorption, dielectric strength (400 volts per mil, approx.), tensile strength (11,000 lbs. per sq. in.), material has resistance to abrasion, flexibility in some forms, heat resistance (275 degrees Fahr.), availability in colors (red, gray, black) and is shatterproof. Used for electrical insulation where arc resistance is important. For mechanical insulation where moderate moisture resistance is important.

W

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WESTFELT—Western Felt Works, Chicago. Felt material; furnished in cut shapes according to user's specifications. Used for vibration dampening, deadening sound, insulating against heat and cold and filtering liquids, air and gases. Material also furnished as oil or dust seals for bearings.

For further information see ad. on page 39D.

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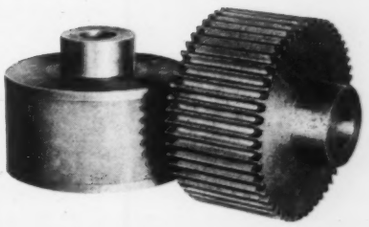
WILMINGTON FIBRE—Wilmington Fibre Specialty Co., Wilmington, Del. Cotton rag and paper, chemically treated, nonplastic material; furnished in sheet form or rods and tubes for machining or stamping into parts. Besides dielectric strength (200-400 volts per mil), tensile strength (12,000-15,000 lbs. per sq. in.) and resistance to shock, material has corrosion resistance, high polish and availability in colors. Used for electrical and mechanical insulation.

For further information see ad. on page 45D.

1—Corrosion resistance; 2—High heat resistance; 3—Impact resistance; 4—High tensile strength; 5—High dielectric strength; 6—Nonflammable; 7—Takes high polish; 8—Translucence; 9—Available in colors; 10—Low moisture absorption

Set the Pace FOR COMPETITION WITH INSUROK THE SUPERIOR PLASTIC



SWIFT changes are appearing in countless products today. In a vast number, INSUROK — the modern plastic by Richardson, either laminated or molded — is effecting the modernization, adding strength, durability, utility, efficiency, value, new sales appeal. Keep ahead of competition . . . investigate the application of INSUROK to your product and production processes, now.

The Richardson departments of Engineering, Research and Design are at your service without obligation.

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The Industrial Steel Casting Co.

Division of

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Toledo, Ohio

Western Felt

at your service . . .

• Western's 37 years of experience in manufacturing and cutting felt is at your disposal. Extensive laboratory facilities insure the best possible solution to your problems. You are under no obligation whatsoever in making use of our free research services. Write today.

Just a few of the many uses of Western Felt:

Sound Deadening — Sealing Bearings
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Branches: New York, Philadelphia, Boston, Cleveland, Detroit, Cincinnati, St. Louis, San Francisco, Los Angeles, Dallas, Portland, Ore., Seattle, Wash.

Alphabetical Listing of Producers of Design Materials

I—Iron, Steel and Nonferrous Alloys

(For properties, uses, etc., of each material, see page 9 D.)

Acme Steel Co., 2840 Archer Ave., Chicago
Stainless strip steels—ACME

Allan, A., & Son, 601 Bergen St., Harrison, N. J.
Copper lead-bearing alloy — ALLAN RED METAL

Allegheny Steel Co., Brackenridge, Pa.
Stainless steels—ALLEGHENY

Alloy Cast Steel Co., Marion, O.
Cast alloy steels — CAST ALLOY STEELS

Aluminum Co. of America, 634 Gulf Bldg., Pittsburgh.
Aluminum alloys—ALCOA

Aluminum Industries Inc., 2438 Beekman St., Cincinnati.
Aluminum base alloys—PERMITE

American Brass Co., Waterbury, Conn.
Aluminum bronze alloy—AMBRALOY
Copper-aluminum alloy—AVIALITE
Copper aluminum and nickel alloy — TEMPALOY
Corrosion resistant alloys — AMBRAC, TOBIN BRONZE, ANACONDA EVERDUR and MUNTZ METAL

American Magnesium Corp., 2210 Harvard Ave., Cleveland.
Magnesium alloys—MAZLO

American Manganese Steel Co. Inc., Chicago Heights, Ill.
Cast steels and welding rods—AMSCO

American Rolling Mill Co., Middletown, O.
Stainless and high tensile steels — ARMCO
High silicon steel—TRAN-COR 60
Pure iron—ARMCO Ingot Iron

American Smelting & Refining Co., Equitable Bldg., New York.
Cadmium-nickel bearing alloy—ASARCOLOY NO. 7

American Stainless Steel Co., Commonwealth Bldg., Pittsburgh.
Corrosion resistant alloys—AMERICAN

American Steel Foundries, 410 No. Michigan Ave., Chicago.
High strength cast steel—HYLASTIC

Ampco Metal Inc., 3830 West Burnham St., Milwaukee.
Corrosion and shock resistant alloys—AMPCO METAL

Amplex Mfg. Co., div. of Chrysler Corp., 6500 Harper Ave., Detroit.
(*See Chrysler Corp.*)

Anchor Drawn Steel Co., Latrobe, Pa.
High carbon steel—RED ANCHOR

Antaciron, Inc., Wellsville, N. Y.
Corrosion resistant alloy—ANTACIRON

Apex Smelting Co., 2554 Fillmore St., Chicago.
Zinc base die cast alloy—APEX

Apollo Steel Co., Apollo, Pa.
Copper-bearing steel—APOLLOY METAL

Aurora Metal Co., 614 West Park Ave., Aurora, Ill.
Aluminum bronze alloy—AUROMET

Babcock & Wilcox Co., 19 Rector St., New York.
Corrosion and heat resisting alloys—ADAMANTINE and ELVERITE

Babcock & Wilcox Tube Co., Beaver Falls, Pa.
Corrosion and heat resisting steel tubes—B & W CROLOY

Baker & Co. Inc., 54 Austin St., Newark, N. J.
Platinum alloy—BAKER

Bearium Metals Corp., 258 State St., Rochester, N. Y.
Bearium-processed lead alloys—BEARIUM

Belle City Malleable Iron Co., Racine, Wis.
Pearlitic malleable iron — BELMALLOY

Bethlehem Foundry & Machine Co., Bethlehem, Pa.
Silicon Cast Iron—TANTIRON

Bethlehem Steel Co., Bethlehem, Pa.
Corrosion resistant alloy steels — BETHADUR and CROMANSIL
Copper bearing steel—BETH-CU-LOY
Stainless steel—BETHALON
High carbon, manganese and nickel steels; and chromium-molybdenum steel castings—BETHLEHEM
Special carbon spring steel—ENDURIA
Silico-manganese steel—RESILIA
High temperature alloy steel—SUPERTEMP
Nickel chromium irons—MAYARI ALLOY IRON and MAYARI STEELS
Chromium-nickel-copper-silicon steel—MAYARI R
Nitriding steel—NITRALLOY

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Alloy cast steels—BIRDSBORO

Blackor Co., 13007 S. Main St., Los Angeles.
Cemented carbide wear resisting material—BLACKOR

Bohn Aluminum Co., Lafayette Bldg., Detroit.
Light aluminum alloy—BOHNALITE

Boker, H., & Co. Inc., 101 Duane St., New York.
High chromium steel—KINITE

Bonney-Floyd Co., Marion Rd., Columbus, O.
Alloy cast steel—BONNEY-FLOYD

Bridgeport Brass Co., Bridgeport, Conn.
High copper silicon bronzes — DURONZE
Copper and zinc alloys—BRIDGEPORT

Buckeye Brass & Mfg. Co., 6410 Hawthorne, Cleveland.
Bearing bronzes—COMMERCIAL, HYSPEED and LUBRICO

Bunting Brass & Bronze Co., Spencer and Carlton Sts., Toledo, O.
Bearing bronzes—BUNTING

Burgess-Parr Co., Freeport, Ill.
Acid resisting alloys—ILLIUM

Cadman, A. W., Mfg. Co., 2816 Smallman St., Pittsburgh.
Nickel bronze alloy—NICUITE
Babbitt metal—BEARITE and ACORN

Calorizing Co., The, Wilkinsburg Station, Pittsburgh.
Corrosion and heat resisting alloys—CALITE and CALITE-NIROSTA

Campbell, Wyant & Cannon Foundry Co., Muskegon Heights, Mich.
High strength cast irons—CANNONITE and PROFERALL

Cannon-Stein Steel Corp., 817 S. State St., Syracuse.
Manganese and chrome nickel steels—RITA

Carboloy Co., Inc., 2985 E. Jefferson Ave., Detroit.
Cemented carbide—CARBOLOY

Carnegie-Illinois Steel Corp., Carnegie Bldg., Pittsburgh.
Low alloy steel—CROMANSIL
Abrasion resisting alloy—AR STEEL

Carpenter Steel Co., Reading, Pa.
Carbon, chromium and chrome nickel steels—CARPENTER
Nickel-chrome steels—SAMSON

Castings Corp., 666 Andrews Bldg., Buffalo.
Corrosion and wear resisting malleable iron—Z-METAL
Corrosion and heat resisting alloys—STERLING

Cerro de Pasco Copper Corp., 44 Wall St., New York.
Bismuth-lead-tin-antimony castings — CERROMATRIX, CERROBASE and CERROBEND

Chace, W. M., Co., 1616 Beard Ave., Detroit.
Thermostatic metal—BIMETAL

Chambersburg Engineering Co., Chambersburg, Pa.
Nickel-molubdenum iron alloys — CECOLLOY

Chapman Valve Mfg. Co., Indian Orchard, Mass.
Corrosion resisting iron — DAVIS METAL

Chase Brass & Copper Co., Waterbury, Conn.
Corrosion resistant copper alloys — OLYMPIC BRONZE, ADMIRALTY BRONZE, CHAMET BRONZE, CORVIC BRONZE, CHASE and MUNTZ METAL

Chicago Steel Foundry Co., 3720 S. Kedzie Ave., Chicago.
Alloy cast steels — EVANSTEEL and PYRASTEEL

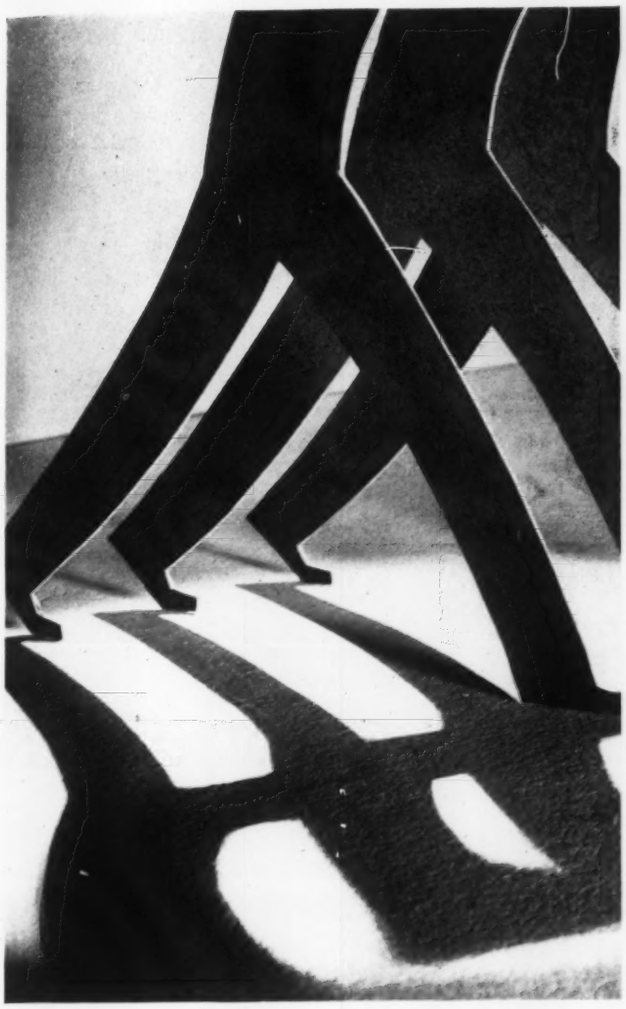
Chrysler Corp., Amplex Div., 6500 Harper Ave., Detroit.
Bearing bronze—OILITE

Climax Molybdenum Co., 500 Fifth Ave., New York.
Molybdenum steel — MO-LYB-DEN-UM

Colmonoy Inc., P. O. Box 977, Los Nietos, Calif.
Corrosion and wear resisting alloys—COLMONOY

Columbia Steel & Shafting Co., Pittsburgh, Pa.
High tensile steel—COLUMBIA

Continental Roll & Steel Foundry Co., East Chicago, Ind.
Hard alloys for rolls — DUQUESNE



all IN OUR STRIDE

Plastics vary. Each, though, has its own peculiarities and problems . . . and Auburn Button Works knows them all. Auburn has taken every one of them in its stride. More than sixty years molding experience has brought Auburn early familiarity with every new plastic development . . . with its limitations and advantages. Whatever the job, if it has to do with molded plastics, Auburn can do it better and more economically. If it's a problem of design, of scheduled production or of the selection of the proper plastic, Auburn's long experience will be of decided benefit to you in its solution.

We mold Bakelite, Durez, Resinox, Lucite,
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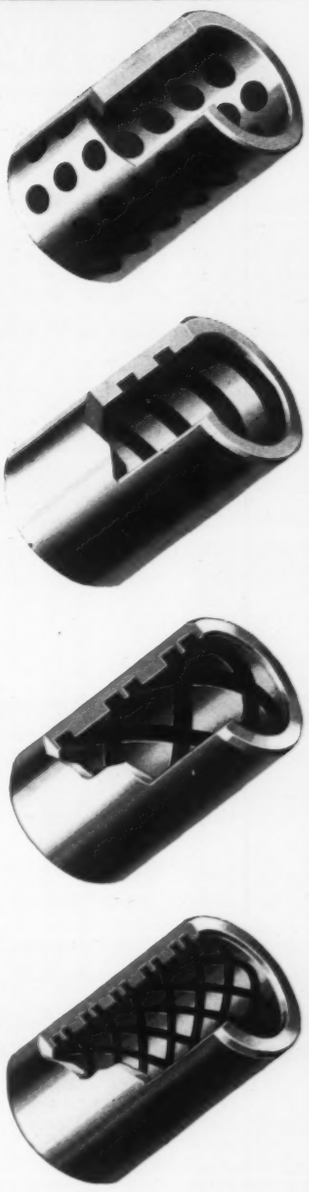
Established 1876

MOLDED PLASTICS DIVISION OF
AUBURN BUTTON WORKS, Inc.
AUBURN, N. Y.



WHEN you buy Graphited Oil-less Bearings make sure that the bearing is properly designed or you may get less than the performance you expect.

Graphited Oil-less Bearings should be designed and made exactly to meet the requirements of the application under consideration. The style of grooving employed for the graphite composition, the apportionment of bearing contact surfaces (bronze to graphite), are points that have everything to do with the service rendered by the bearing.

Bunting engineering makes it possible to extend the use of this type of bearing to many new applications. Flanged Bushings and Thrust Washers of any size or design also can be obtained in Bunting Graphited Bronze.

We will gladly aid you, without cost or obligation, in making up specifications for Graphited Oil-less Bearings and quote you on such requirements. The Bunting Brass & Bronze Company, Toledo, Ohio . . . Branches and Warehouses in all Principal Cities.

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BRONZE BUSHINGS • BEARINGS
MACHINED AND CENTERED BRONZE BARS
BABBITT METALS

SPECIAL, CROMONITE and HUBBARD SPECIAL
Alloy cast steels—DYNAMIC STEEL, MOLYBDENITE and TEMP ALLOY

Continental Steel Corp., Kokomo, Ind.
Case hardening steel—KONIK

Cooper Alloy Foundry Co., 150 Broadway, Elizabeth, N. J.
Corrosion and heat resisting cast alloys—COOPER ALLOY

Crucible Steel Co. of America, 405 Lexington Ave., New York.
High strength alloy steels—DUPLEX, MAX-EL and SIMPLEX
Corrosion and heat resistant alloys—LO CRO and REZISTAL

Detroit Alloy Steel Co., 6500 Wight St., Detroit.
Alloy steel castings—KROKOLOY and CASTALOY
Oil hardening tool steel castings—CARBOMANG

Doehler Die Casting Co., 386 Fourth Ave., New York.
Copper base alloys—BRASTIL and DOLER NIKLBRASS
Copper-zinc-silicon alloys—DOLER BRASS, DOLER ZINC
Aluminum base alloys—DOLER ALCULOY, DOLER ALSILOY
Magnesium base alloys—DOLER MAG

Dow Chemical Co., Midland, Mich.
Corrosion resistant light alloys—DOWMETAL

Driver-Harris Co., Harrison, N. J.
Corrosion, heat and wear resisting alloys—ADVANCE, NILVAR, CHROMAX, CIMET, NICHROME and HYTEMCO

Driver, Wilbur B., Co., Riverside Ave., Newark, N. J.
Nickel copper alloy—CUPRON
Nickel-chromium-iron—CROMIN D
Copper, nickel and manganese alloys—MANGANIN
Heat resistant wire—TOPHET

Duraloy Co., 12 E. 41st St., New York.
Corrosion and heat resisting alloys—DURALOY

Duriron Co. Inc., Dayton, O.
Corrosion and heat resistant alloys—ALCUMITE, DURICHLOR, DURIMET, DURIRON and DURCO

Electro-Alloys Co., Elyria, O.
Corrosion and heat resisting alloys—THERMALLOY

Electro Metallurgical Sales Corp., 30 East 42nd St., New York.
Ferro-alloy—ELECTROMET

Empire Steel Castings Co. Inc., Reading, Pa.
Corrosion, heat and wear resisting cast steel—EMPIRE
Nitriding cast steel—NITRALLOY

Erie Malleable Iron Co., Erie, Pa.
Corrosion and wear resisting malleable iron—ERMAL and ERMALITE

Farrell-Cheek Steel Co., Sandusky, O.
Abrasion, wear and shock resisting cast steel—FARRELL'S 85

Federal Mogul Corp., 11031 Shoemaker Ave., Detroit.
Bearing bronzes—FEDERAL MOGUL

Ferner, R. Y., Co., 161 Devonshire St., Boston.
Corrosion and heat resisting alloys—ELINVAR
Alloy with low coefficient of expansion—INVAR

Finkl, A., & Sons Co., 2011 N. Southport Ave., Chicago.
Special alloy steel—MOLYBDIE

Firth-Sterling Steel Co., McKeesport, Pa.
Carbon tool steels—STERLING
Cemented carbides—FIRTHITE

Fredericksen Co., Saginaw, Mich.
Bearing bronzes—SABECO

General Alloys Co., 367-405 W. First St., Boston.
Corrosion, heat and wear resisting alloys—X-ITE, Q-ALLOYS and ECONOMET

General Electric Co., Schenectady, N. Y.
Magnet alloy—ALNICO
Welding electrode—TRODALOY NO. 1

Graphite Metallizing Corp., Yonkers, N. Y.
Copper and babbitt metals—GRAPHALLOY

Gunite Foundries Corp., Rockford, Ill.
High test cast iron—GUNITE
Heat-treated white iron—Z-METAL

Halcomb Steel Co., Syracuse, N. Y.
Stainless Steels—HALCOMB

Haynes Stellite Co., 205 E. 42nd St., New York.
Heat and wear resistant alloys—HAYSTELLITE, HAYNES STELLITE and HASCROME
Corrosion resistant alloy—HASTELLOY

Heppenstall Co., Hatfield St., Pittsburgh.
Abrasion resistant alloy steels—HARDTEM and KLEENKUT
High strength alloy steel—HEPPENSTALL
Nickel chrome molybdenum steel—PYRODIE

Hevi Duty Electric Co., 4212 W. Highland Blvd., Milwaukee.
Heat resistant element—ALLOY NO. 10

Hoskins Mfg. Co., 4445 Lawton Ave., Detroit.
Heating element alloys—CHROMEL

Hybinette, Victor, Wilmington, Del.
Nickel-chrome alloy—HYBNICKEL

Ingersoll Steel & Disc Co., Division of Borg-Warner Corp., Straus Bldg., Chicago.
Stainless clad steel—INGACLAD

Inland Steel Co., 38 S. Dearborn St., Chicago.
High strength, corrosion resistant and copper bearing steels, and spring steel—INLAND HI-STEEL

International Nickel Co. Inc., 67 Wall St., New York.
Corrosion, heat and wear resisting alloys—NI-TENSYLIRON, NI-HARD, NI-RESIST, MONEL METAL and INCONEL
High tensile strength alloy—HIGH TEST

C. O. Jelliff Mfg. Corp., Southport, Conn.
Resistance alloys—JELLIFF and KANTHAL

Jewell Alloy & Malleable Co., Buffalo, N. Y.
Heat resisting cast alloy—JEWELL-ALLOY

Johnson Bronze Co., New Castle, Pa.
Bearing metals—JOHNSON

Jones & Laughlin Steel Corp., Jones & Laughlin Bldg., Pittsburgh.
High tensile steel—JAL-TEN
Free machining steel—JALCASE

Lake City Malleable Co., 5060 Lakeside Ave., Cleveland.
Malleable iron—SHOCKPROOF

Latrobe Electric Steel Co., Latrobe, Pa.
Nondeforming tool steel—MANGANO

Lehigh Babbitt Co., Box 504, Allentown, Pa.
Graphite and babbitt metals—GRAPHO BABBITT METAL

Lincoln Electric Co., 12818 Coit Rd., Cleveland.
High tensile welding rods—SHIELD-ARC, LIGHTWELD, MANGANWELD, WEARWELD, HARDWELD, ABRASOWELD, TOOLWELD, and AERISWELD

Linde Air Products Co., 205 East 42nd St., New York.
Welding rods—OXWELD

Link-Belt Co., 220 S. Belmont Ave., Indianapolis.
Malleable cast iron—PROMAL

Ludlum Steel Co., Watervliet, N. Y.
Special alloy tool steels—ATLAS; PYTHON; SEMINOLE and TETON
Nondeforming tool steel—DEWARD
Carbon tool steel—POMPTON
Rust resisting steels—SILCROME
Cast iron—NITRICASTIRON
Nitriding steel—NITRALLOY
High speed steel—LXX

Lukens Steel Co., Coatesville, Pa.
Steels varying in analysis—LUKENS

Lumen Bearing Co., Buffalo.
Wear resisting—MACHINEBRONZE
High tin babbitt—STANNUM BABBITT
Lead base bearing babbitt—LOTUS BABBITT
Bearing alloys—LUMEN ALLOYS

Mackenzie's, Duncan, Sons Co., Inc., Trenton, N. J.
Heat resisting alloy—MACKENITE METAL

Mackintosh-Hemphill Co., 901 Bingham St., Pittsburgh.
Wear resisting steel and iron—ADAMITE
Wear resisting iron—IRALITE
High strength alloy steel—MACHEMPITE "Wearprooft".

Mallory, P. R., & Co. Inc., Indianapolis.
Hard surfacing material—MAL-ARC
Welding electrodes—ELKALOY
Wear resistant alloy—ELKONITE
Copper base alloys—MALLORY

Massillon Steel Casting Co., Massillon, O.
Alloy cast steel—MASSILLON and TIGERLOY
Nitriding steel—NITRALLOY

Maurath Inc., 7301 Union Ave., Cleveland.
Welding rod—MAURATH

McGill Mfg. Co., Valparaiso, Ind.
Corrosion resistant alloys—MCGILL

Meehanite Metal Corp., Pittsburgh.
Corrosion, abrasion and heat resisting alloy—MEEHANITE

Metal & Thermit Corp., 120 Broadway, New York.
Welding electrodes—MUREX

Michiana Products Corp., Michigan City, Ind.
Corrosion and heat resisting alloys—FIRE ARMOR; MICHIANA; ZORITE

Michigan Steel Casting Co., Ft. of St. Aubin Ave., Detroit.
Heat and corrosion resisting alloys—MISCO

Midvale Co., Nicetown, Philadelphia.
Corrosion and heat resisting alloys—MIDVALOY

Millbury Steel Foundry Co., Millbury, Mass.
Corrosion resistant alloy—NONCORRODITE

Moraine Products Co., 330 East First St., Dayton, O.
Bearing alloys—DUREX and MORAINE

Mueller Brass Co., Port Huron, Mich.
Corrosion resisting alloys—TUFSTUFF and MUELLER 600 BRONZE
Brass for forging—RELLEUM BRASS

National Alloy Steel Co., Blawnox, Pa.
Corrosion and heat resisting castings

National Lead Co., 111 Broadway, New York.
Babbitt metal for bearings—DUTCH BOY BABBITT; HOYT BABBITT METAL
White metal bearing alloy—SATCO

National Malleable & Steel Castings Co., 10600 Quincy Ave., Cleveland.
Alloy cast steel—NACO STEEL
Malleable cast iron—MALLIX

National Smelting Works, 6700 Grant Ave., Cleveland
High speed steel—NATIONAL

New Jersey Zinc Co., 160 Front St., New York.
Zinc alloys—ZAMAK

Newport Rolling Mill Co., Newport, Ky.
Copper-bearing pure iron—GOHI

Niagara Falls Smelting & Refining Corp., Buffalo
Alloying elements—RUINELLA E-1, CATARACT METAL, and NIAGARA

Nicralumin Co., Jackson, Mich.
Light aluminum alloys—NICRAL

Nitricastiron Corp., 230 Park Ave., New York.
Cast iron—NITRICASTIRON

Nitralloy Corp., 230 Park Ave., New York.
Nitriding steel—NITRALLOY

Ohio Steel Foundry Co., Springfield, O.
Corrosion and heat resisting alloys—FAHRITE

★

Acknowledgment

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Machine Design takes this opportunity of thanking all those companies and individuals who cooperated in the compilation of this directory of engineering materials. We are particularly indebted to the manufacturers of the materials for their response to requests for information on their products, and to the advertisers whose collaboration made possible the presentation.

★

MEEHANITE METAL

METAL

TRADE MARK

MEEHANITE

***An* ENGINEERING HIGH STRENGTH IRON**

● Meehanite is an engineering material with definite, improved physical properties made on a dependable basis by a patented process.

Meehanite is made in several grades to fit varying requirements according to the application. The outstanding characteristics are high tensiles, combined with high resilience, impact, compression strength, fatigue resistance, toughness, dense uniform grain structure, good machinability, wear resistance and unusual heat resistance.

Used for machinery parts to withstand high stress and wear – heavy duty gears, engine cylinders, liners, pistons, beds, etc.– metal working dies, bolsters, etc., press frames–pressure castings, rams, cylinders –furnace parts, pots, etc.

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American Laundry Machinery Co. . . . . *Rochester, N. Y.*
Banner Iron Works . . . . . *St. Louis, Mo.*
H. W. Butterworth & Sons . . . . . *Bethayers, Pa.*
Cincinnati Milling Machine Co. . . . . *Cincinnati, Ohio*
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M. H. Detrick Company . . . . . *New York, N. Y.*
Farrel Birmingham Company . . . . . *Ansonia, Conn.*
Florence Pipe Foundry & Machine Co. . . . . *Florence, N. J.*
Fulton Foundry & Machine Co. . . . . *Cleveland, Ohio*
Greenlee Foundry Company . . . . . *Chicago, Ill.*
G. H. R. Foundry Company . . . . . *Dayton, Ohio*
Hamilton Foundry & Machine Co. . . . . *Hamilton, Ohio*
Kanawha Manufacturing Co. . . . . *Charleston, W. Va.*
Kinney Iron Works . . . . . *San Francisco, Calif.*
Michigan Valve & Foundry Co. . . . . *Detroit, Mich.*
Rosedale Foundry & Machine Co. . . . . *Pittsburgh, Pa.*
Ross-Meehan Foundries . . . . . *Chattanooga, Tenn.*
Vulcan Foundry Company . . . . . *Oakland, Calif.*
Warren Foundry & Pipe Corp. . . *Phillipsburg, N. J.*

Alloy cast steels—HIOLOY

Pacific Foundry Co., 2100 Nineteenth St., San Francisco.
Corrosion and wear resisting cast alloys—FLINTCAST; and PYROCAST

Phelps Dodge Copper Products Corp., New York.
High tensile silicon bronze — PMG METAL

Pioneer Alloy Products Co. Inc., 16601 Euclid Ave., Cleveland.
Heat resisting—Cr-Ni-Mo alloy and acid resisting Ni-Cr-Mo alloy—PIONEER

Precision Castings Co. Inc., Syracuse, N. Y.
Aluminum base alloys—PRECISION

Q & C Co., 90 West St., New York.
Heat and abrasion resisting alloy — NOGROTH

Reading Iron Co., 404 N. Broad St., Philadelphia.
Bar iron—NORDIC IRON

Republic Steel Corp., Republic Bldg., Cleveland.
Open hearth iron alloy — TONCAN IRON
Stainless and heat resisting alloys—ENDURO
High strength alloy—AGATHON

Resisto-Loy Co., Grand Rapids, Mich.
Corrosion and abrasion resistant — ISOROD, RESISTO-LOY

Revere Copper & Brass Inc., 230 Park Ave., New York.
Non-magnetic, corrosion resistant, silicon bronze—HERCULOY
Bearing bronze—ROMAN BRONZE

Rhoades, R. W., Metaline Co. Inc., P. O. Box No. 1, Long Island City, N. Y.
Heat resisting bearing bronze—METALINE

Riverside Metal Co., Riverside, N. J.
Copper-tin-nickel-zinc alloy — RIVERSIDE

Ruselite Corp., 1025 N. Fourth St., Milwaukee, Wis.
High tensile bronze — TANTALUM BRONZE

Rustless Iron & Steel Corp., 3400 East Chase St., Baltimore.
Chrome and chrome nickel stainless steels — DEFIRUST, DEFIHEAT, DEFISTAIN and RUSTLESS 17

Seymour Mfg. Co., Seymour, Conn.
High corrosion resisting alloys—SEYMOUR and SEYMOURITE

Shawinigan Chemicals Ltd., Montreal, Que.
Heat and corrosion resistant alloys—SHAWINIGAN

Sheet Aluminum Corp., Jackson, Mich.
Corrosion and heat resisting alloys—HYB-LUM

Sivyer Steel Casting Co., 1675 S. 43rd St., Milwaukee.
Corrosion and heat resisting cast steels —SIVYER
Abrasion resisting cast steel—SIVYER
Alloy cast steels—SIVYER

Smith Steel Foundry Co., 1320 S. First St., Milwaukee.
High magnetic permeability alloy — SMITH DYNAMO STEEL

Standard Alloy Co., 1679 Collamer Ave., Cleveland.
Corrosion and heat resisting alloys—STANDARD-ALLOY

Stoody Co., Whittier, Calif.
Wear resisting alloys — STOODITE, STOODITE (Numbered), STOODY (Self-Hardening), SILFRAM and BORIUM

Sumet Corp., 1543 Filmore Ave., Buffalo.
Bronze bearings—SUMET

Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
Corrosion and heat resisting alloys—TISCO
Austenitic wear resisting steel — TIMANG

Timken Steel & Tube Division, The Timken Roller Bearing Co., Canton, O.
Creep resisting alloy steels — DM STEEL and SICROMO STEEL

Titanium Alloy Mfg. Co., Niagara Falls, N. Y.
Extra low carbon trimming steel — TAMCO

True Alloys Inc., Detroit.
Aluminum-bronze alloys — TRUALOY

Union Drawn Steel Co., Massillon, O.
Cold drawn steels—UNION

Union Steel Casting Co., Sixty-second and Butler Sts., Pittsburgh.
Alloy cast steel—UNIVAN

United States Steel Corp., 434 Fifth Ave., Pittsburgh.
Stainless steels—USS
Atmospheric corrosion and abrasion resistant-alloy — COR-TEN, SILTEN and MAN-TEN

Universal Cyclops Steel Co., Titusville, Pa.
Corrosion and heat resisting alloys—CYCLOPS; UNILOY
Nondeforming tool steel — CYCLOPS WANDO
Special alloy tool steel — CYCLOPS ORION

Vanadium-Alloys Steel Co., Latrobe, Pa.
High strength alloy steels—NIKRO M and VANADIUM
Nitriding steel—NITRALLOY
Abrasion resistant—MACALLOY

Vanadium Corp. of America, 420 Lexington Ave., New York.
Ferro-alloy—VANCORAM

Washington Iron Works, Seattle, Wash.
High strength alloy steels—SUPERLOY

Waukesha Foundry Co., North Chicago, Ill.
Copper-base alloy—WAUKESHA

Weatherly Foundry & Mfg. Co., Weatherly, Pa.
Heat and abrasion resisting alloys—DIAMITE and MOLY-IRON

Wellman Bronze & Aluminum Co., 6017 Superior Ave., Cleveland.
Copper-tin-zinc-lead alloys—IDEALOY and ANFRILOY

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Corrosion and heat resisting alloy — KONAL and PHOS-COPPER
Magnetic alloy—HIPERNIK
Gas type metal—KOVAR
Copper base alloy—CUPALOY

West Steel Casting Co., 805 E. 70th St., Cleveland.
Molubdenum-vanadium-nickel alloy — CUMLOY
High tensile strength alloy — DURACAST

Wheeling Steel Corp., Wheeling, W. Va.
Low carbon steel—COP-R-LOY

Wheelock, Lovejoy & Co. Inc., 128 Sidney St., Cambridge, Mass.
Machinery steels—ECONOMO and HY-TEN

Williams, E. A., & Son Inc., 111 Plymouth St., Jersey City, N. J.
Babbitt metals for bearings—CLOVERLEAF, DIAMOND G BRONZE and MILL BRASS MIX

Wilson, H. A., Co., Newark, N. J.
Thermostatic bimetal—THERMOMETAL and WILCO

Wood, Alan, Steel Co., Conshohocken, Pa.
Copper-phosphorus alloys—AW

Worthington Pump & Machinery Corp., Harrison, N. J.
Corrosion and heat resisting cast iron —WORTHITE

Youngstown Sheet & Tube Co., Youngstown, O.
High strength alloy steel—YOLOY

II—Plastics and other Nonmetallics

(For properties, uses, etc., of each material, see page 28-D.)

Advance Solvents & Chemical Corp., 245 Fifth Ave., New York.
Transparent molding material—RESOGLAZ

Aetna Rubber Co., 815 E. 79th St., Cleveland.
Hard rubber—AETNA

American Cyanamid Co., Beetleware Div., 30 Rockefeller Plaza, New York.
Urea formaldehyde plastic—BEETLE

American Hard Rubber Co., 11 Mercer St., New York.
Hard rubber—ACE

American Plastics Corp., 50 Union Square, New York.
Casein plastic—AMEROID

Armstrong Cork Products Co., Lancaster, Pa.
Cork and synthetic rubber compound—CORPRENE
Resilient board of cork granules — VIBRACORK

Atlas Powder Co., Zapan Div., Stamford, Conn.
Cloth base and Bakelite resinous plastic—REVOLITE

Bakelite Corp., 247 Park Ave., New York.
Phenolic plastics—BAKELITE

Booth Felt Co., 444—19th St., Brooklyn, N. Y.
Wool base felt—BOOTH FELT

Bound Brook Oil-less Bearings Co., Bound Brook, N. J.
Material for impregnated wood bushings, etc.—NIGRUM

Continental Diamond Fibre Co., Newark, Del.
Phenolic plastic—DILECTO
Resinous plastic — VULCOID, DILOPHANE, CELLANITE and CELORON
Vulcanized fibre—CODITE
Fibrous, flexible material—MICABOND

Carbide & Carbon Chemicals Corp., 30 E. 42nd St., New York.
Resinous plastic—VINYLITE

Catalin Corp., 1 Park Ave., New York.

Here's

WHY

COMPARISON OF OTHER BASIC MATERIALS WITH WILMINGTON VULCANIZED FIBRE

Wilmington Vulcanized Fibre is ideal for Maintenance Work - - - - -

STOCK A SMALL QUANTITY OF SHEETS, RODS, TUBES

	Insulating Properties	Effect of Age	Effect of Oils	Effect of Water	Effect of Heat	Effect of Acids	Effect of Hammer Blow	Effect of Rodents, Vermin, etc
WILMINGTON FIBRE	Non-conductor	Improves	None	Swells	None	None	None	None
CAST IRON	Conductor	None	None	Rusts	None	Corrodes	Breaks	None
STEEL	Conductor	None	None	Rusts	None	Corrodes	Breaks	None
BRASS	Conductor	None	None	None	None	Corrodes	Dents	None
COPPER	Conductor	None	None	None	None	Corrodes	Dents	None
ZINC	Conductor	None	None	None	None	Corrodes	Breaks	None
PORCELAIN	Non-conductor	None	None	None	None	None	Breaks	None
GLASS	Non-conductor	None	None	None	None	None	Breaks	None
WOOD	Non-conductor	None (dry)	Absorbs	Swells	Chars or Burns Easily	Destroys	Dents or Breaks	Destroys
RUBBER	Non-conductor	Deteriorates	Deteriorates	Rots	Destroys "Life"		None	
GUTTA PERCHA	Non-conductor	Deteriorates			Softens		Breaks	
LEATHER	Non-conductor	Deteriorates	Absorbs	Rots	Destroys "Life"	Destroys	Bruises	Destroys
BONE	Non-conductor	None	Absorbs	Rots	Chars	Destroys	Breaks	Destroys

WILMINGTON FIBRE SPECIALTY COMPANY

MANUFACTURERS OF GENUINE VULCANIZED FIBRE

WILMINGTON, DELAWARE

American Felt Company

TRADE MARK

"Manufacturers of Quality Felts for All Mechanical Purposes"

"Prompt Engineering Service on Request"

●

FELT MILLS AT:

Newburgh, N. Y.—Glenville, Conn.
Franklin, Mass.
City Mills, Mass.

●

CUTTING SHOPS AT:

Detroit, Mich.
Port Chester, N. Y.

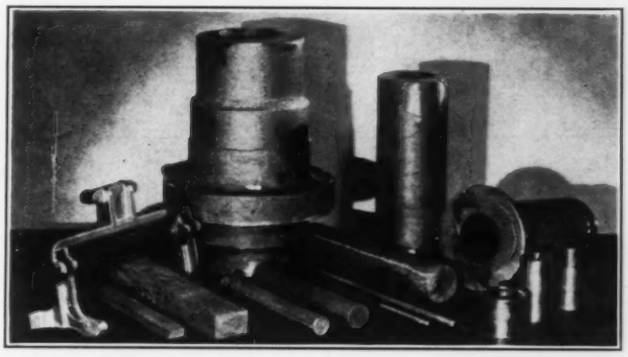
●

315 FOURTH AVE., NEW YORK CITY

Chicago Detroit Boston

FOR

EXTRA STRENGTH AND WEAR



USE

AMPCO *cast by* WELLMAN

For heavy duty service and for those installations wherein exceptionally long-wearing bronze is vital to the maintained accuracy of the product, Wellman recommends Ampco, the tough, durable bronze of bronzes.

Ampco's compressive strength adds endurance and fatigue-resistant, long wearing qualities to the product. The illustration above shows just a few of the many Ampco castings made by Wellman in one single day.

Designers and builders of equipment and special machinery everywhere are specifying Ampco Metal wherever hard wear, severe strains and shocks, or undue pressures are encountered.

Consult with Wellman for castings in this heavy duty bronze.

The WELLMAN
Bronze and Aluminum Co.
5900 SUPERIOR AVENUE
CLEVELAND OHIO

CASTINGS • PLATED PARTS
MACHINED PARTS • BENT TUBES